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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 651

Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ May 8, 1918

A FARM-MANAGEMENT STUDY IN ANDERSON COUNTY, SOUTH CAROLINA.

By A. G. Smith, *Agriculturist.*

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INTRODUCTION.

In a farm-management and cost-determination survey of 112 farms in Williamston, Belton, Broadway, and Honeapath Townships, in Anderson County, S. C. (see fig. 1), it was found that in the organization and operation of the farms there are three outstanding factors that determine the degree of success. These are (1) yields; (2) efficiency in use of labor and equipment, or, as it may be indicated in this region, the acres of crops grown per work animal; and (3) the combination of enterprises. Aside from these there are minor factors, some of which are at times important; but the farmer who shows a high degree of skill in keeping up yields, utilizing labor and equipment, and in combining the proper enterprises in the proper proportions in the farm organization is almost invariably successful.

A correlation study made from the data of the survey showed that, as far as the methods used on these farms were concerned, yields constituted 62 per cent, acres per work animal 22 per cent, and the combination of enterprises 16 per cent of the total weight of the three factors in influencing the per cent return on the investment. Thus it might be said that yields were three times as important as acres per work animal and four times as important as

combination of enterprises. This shows the relative importance of the major features of the farm-management problem and is an indication of how the effort to improve these farms should be divided.

The purpose of this bulletin is to show the bearing of these outstanding factors on the business of the farms surveyed, their influ-

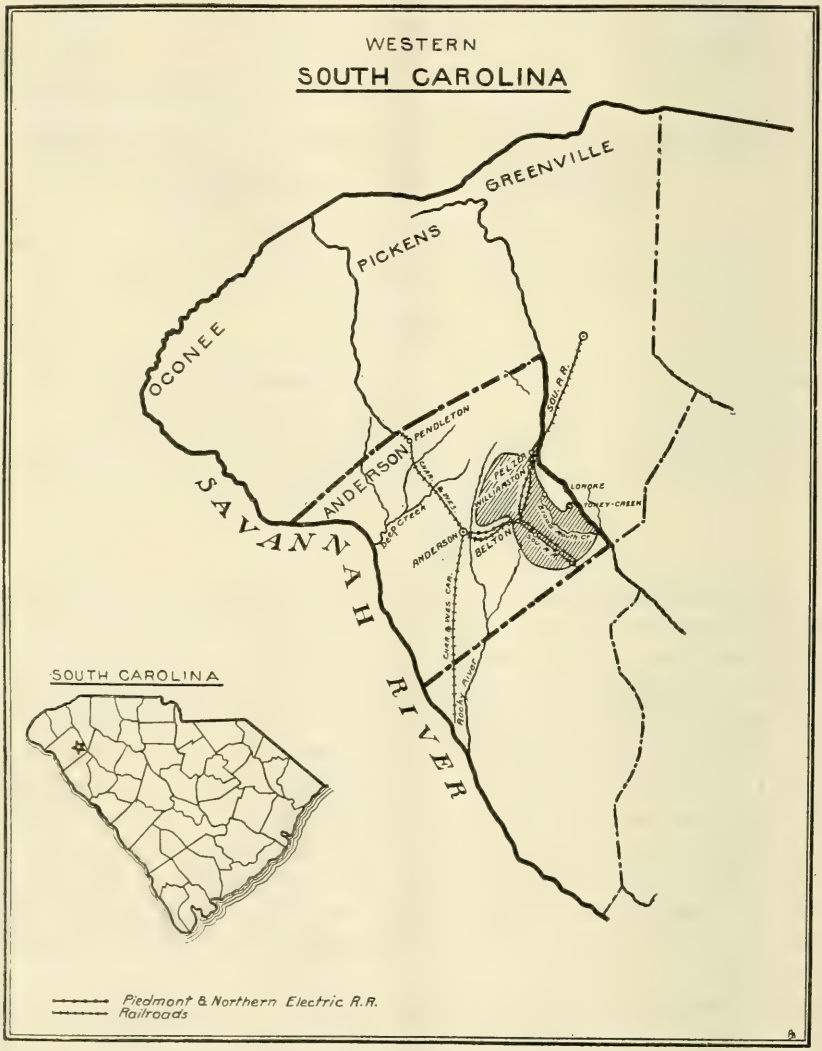

FIG. 1.—Map showing district surveyed (shaded area).

ence on farm efficiency, and how that efficiency can be improved. Effort has been made to make the discussions such that anyone operating a farm under the conditions that prevail on the farms surveyed may, by applying the principles laid down, organize and operate his farm with a high probability of success. Many local and individual forces may suggest deviations from the general plan, but,

with rare exceptions, wide deviations from it probably will be followed by reduced returns.[1]

For the sake of a short name the territory from which the data used in this bulletin were gathered will be called the Belton area, as Belton is one of the principal towns of the region and is centrally located in the area surveyed.

In making the survey the average yield and average selling price of crops were recorded, not only for the then current year, but also for the five years prior to that of the survey (1914). The price of cotton for the year 1914, owing to the European war, was very low, and records based on that price would have been abnormal. For that reason, in computing the records, the average price of cotton for the five years prior to 1914 was used instead of the current price. The value of corn, oats, and cowpea hay was found to be practically the same in 1914 as the average of the previous five years, so no substitution of prices was necessary for these crops. It was found that the average yields of the more important crops for 1914 and for the five-year average were practically the same. The survey records, therefore, can be taken as typical of the farms, and by using the normal price of cotton the results for 1914 can be considered as closely approximating the average conditions for the region.

The 112 farms may be said to constitute a representative cross-section of the region.

SUMMARY.

The more important facts and conclusions brought out in this bulletin are, in brief, as follows:

Cost of producing the principal crops on the 112 farms studied: Cotton, 10.89 cents per pound gross lint; corn, $1 per bushel; oats, 43.3 cents per bushel; oat hay, $13.88 per ton; and cowpea hay, $14.10 per ton. Cotton was produced at its market value when yields were 240 pounds of net lint per acre and corn when yields were 17 bushels per acre.

Taking the crops as a whole, man labor was the largest item of cost and mule labor next. The rent of the land and the fertilizer cost were practically the same.

The farms made 3.65 per cent on the investment, and after deducting 8 per cent on the movable capital, the return on the investment in land and buildings was 3 per cent.

In increasing the efficiency of these farms, yields constitute the most important factor. It has thrice the weight in the per cent return on the investment of the acres per work animal and four times the weight of combination of enterprises.

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[1] Acknowledgments are due to Mr. C. E. Hope for making the partial correlation studies and for statistical assistance in compiling the material; also to the southern field men of the Office of Farm Management for assistance in securing the original data.

Thanks are extended to the farmers for the uniform courtesy with which the field men were received while making the survey.

As cotton is the predominating crop on these farms, the yield and acreage of cotton per work animal practically determine the degree of success.

High yields are obtained by using fertilizers, legumes, and good varieties of seed, and by good tillage. Still better yields could be obtained by applying lime also and planting winter cover crops.

Cotton is fertilized most heavily and corn next. Oats and wheat are fertilized lightly, but no fertilizers are applied to cowpeas.

The cost of producing crops on these farms declines rapidly with increase in yields, principally on account of the decrease in man and mule labor required per unit of yield.

Farms that planted from 20 to 23 acres of crops per work animal were the most profitable. Farms that had from 21 to 25, 41 to 45, and 61 to 65 acres of crops, good sizes, respectively, for one, two, and three mule farms, were more profitable than those that had intermediate sizes.

Two-mule farms with a good acreage per mule were the best farms, but there are larger farms under exceptional management which are as profitable.

The cost of producing feed crops is such that it is profitable to grow them only in sufficient quantities to insure a supply for home consumption. The tendency of farmers, and the most profitable procedure, is to grow the necessary home supplies and then grow all the cotton the conditions permit. Likewise the tendency of farmers, and, within certain limits, the most profitable procedure, is to grow more oats and cowpeas and less corn.

The high cost of producing feed makes the area poorly adapted to the production of live stock. Beef cattle, under present conditions, are practically out of the question, but there is a limited opportunity for dairying, particularly where there is a large family. Hogs should be produced on a small scale for home consumption. The small number of chickens kept per farm is due to the limited production of grain and live stock and the consequent small amount of waste feed.

Alfalfa and late Irish potatoes are promising crops for this area. Soy beans and velvet beans also offer possibilities.

As a general proposition, where from 20 to 23 acres of crops are planted per work animal, 40 per cent of the land should be planted in feed crops and 60 per cent in cotton.

DESCRIPTION OF THE AREA.

SOILS.

The 112 farms surveyed are all located on Cecil sandy loam soil. This soil, according to the Bureau of Soils, constitutes 55 per cent of Anderson County. It consists of brownish gray to brown, medium-textured, sandy loam top soil, from 4 to 8 inches deep, which changes

rapidly with increasing depth to a red clay of a rather sandy nature. In nearly every field are local clay areas, or "gall spots," produced by erosion, the erosion being responsible also for some other modifications in the type. In occasional spots, gravel or "rotten stone" is mixed with the top soil and in some places the sand is deeper than in others, and here the soil is referred to as "sandy land." There are also areas where a tinge of yellow is found in the lower soil and the upper subsoil, such places being designated as "mulatto lands," although they are phases of the Cecil sandy loam type. These variations are of minor importance, however, so that, taken altogether, the soils for the area in which the farm-management survey was made were quite uniform, and are therefore not responsible to any considerable degree for the variation in the character and efficiency of the farms.

TOPOGRAPHY AND DRAINAGE.

The topography grades from level to hilly. Most of the land is terraced. The drainage problem is that of keeping the rains from washing gullies on the hillsides and of removing the water from the lowlands. Open ditches are frequently used to carry the surplus water off the hillsides, although in a good system of terracing but little water is allowed to run off. In periods of heavy rainfall the water frequently breaks the terraces, making repairs an expensive item. Where lowlands are drained, open ditches are used exclusively.

TRANSPORTATION FACILITIES AND MARKETS.

Except in continued rainy weather the roads are good, although in some places the grades at all times make the hauling of heavy loads difficult. Steam railroads and trolley lines, each running in three different directions out of Belton, furnish adequate transportation facilities for the region.

The cotton mills in Anderson and adjoining counties afford a good local market for lint cotton, and the cotton-oil mills buy all the cotton seed offered for sale, but for other products the market is limited. Cattle and hogs are either exchanged among farmers or are sold to local butchers. It is almost impossible to sell a veal calf. It is difficult to sell poultry, eggs, and butter. Most farmers who have such products for sale peddle them around town; a few deliver to private customers. There is a limited retail market for vegetables at Honeapath, Belton, Williamston, and Pelzer, largely in the mill communities. In general, the local merchants do not buy country produce for resale to wholesalers, as is the custom in many sections of the country, though there seems to be a growing tendency to do this. There is no wholesale market for hay and grain, but if a surplus is produced some of it may be sold in towns or to neighboring farmers. Owing to these general market conditions, there often exists a close

relationship between the financial success of a farmer and his salesmanship, or ability to find a market for his produce.

The local conditions which make the marketing of poultry and other by-products of the farm unprofitable can be overcome by merchants on the one hand in establishing connections with larger city markets, and by farmers on the other hand by organization as is practiced in many other sections of the country. The great need for increased poultry production warrants a study of this problem and the experience and the information of the Department of Agricultutre are available on request.

LABOR.

Labor is both white and colored and is comparatively abundant and cheap. The monthly wage varies from $12 to $20 per month, the average with house, garden, and wood furnished, approximating $15 per month. Day labor is paid from 50 to 90 cents per day, 70 cents being a fair average. Cropper labor, an arrangement in which

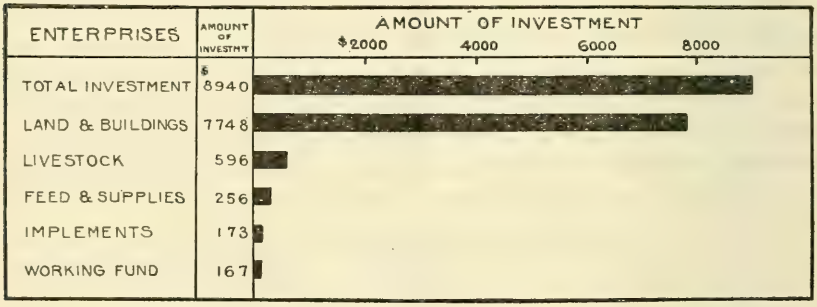

FIG. 2—Investment per farm.

the laborer receives a part of the crop in lieu of wages, is used quite extensively, especially on the larger farms. The average value of the operator's services on 112 farms, aside from perquisites, was estimated at $221 per year.

Women and children do a large part of the work in growing and harvesting crops. Of the total labor costs chargeable to actual crop production, one-third was for labor performed by women and children. This labor is used principally in hoeing and picking cotton. Families are usually large among both the whites and the negroes.

GENERAL CHARACTERISTICS OF THE FARMS SURVEYED.

The largest farm in the area surveyed contained 1,400 acres, of which 895 was in cultivation; the smallest had 15 acres, with 12.5 in cultivation. The average size of the 112 farms was 135.8 acres, with an average of 71.7 acres in cultivation. Exclusive of land rented out, the average size was 119.7 acres, with 63.2 acres, or 52.8 per cent, in cultivation. The total average investment per farm (see fig. 2) was $8,940, distributed as follows: Land and buildings,

$7,748; live stock, $596; implements, $173; feed and supplies, $256; and working fund, $176. The average value of the land was $57.05 per acre. The average rental value of the crop land was $4.23 per acre. The land in cultivation was planted in crops (see fig. 3) in the following percentages: Cotton, 63.1; corn, 23.6; oats, 12.1; wheat, 1.8; and miscellaneous crops, 0.4. One per cent of the crop area was planted in corn after a small-grain crop. Cowpeas, other than those grown in corn and following some other crop, were grown on 9 per cent of the crop area. All the farms (see Table I) planted cotton and corn. More than half planted oats for hay and more

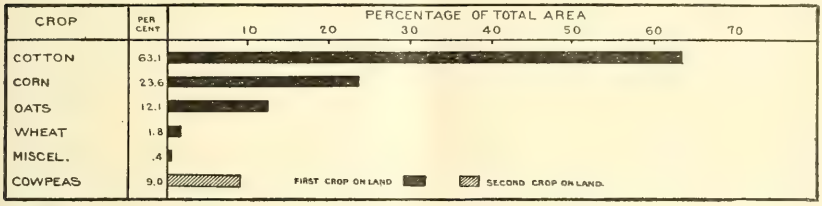

FIG. 3.—Land in crops.

than one-third oats for grain. Also, more than one-third of the farm planted cowpeas unmixed with another crop, for hay alone, while 19 farms planted cowpeas separately for seed. Twenty-one farms grew wheat.

TABLE I.—*Number of farms planting each specified crop, acres per farm, and yield per acre.*

Item.	Cotton.	Corn.	Oats.	Oat hay.	Cowpea hay.	Cowpea seed.	Wheat.	Irish potatoes (1915).
Number of farms planting	112	112	41	68	39	19	21	14
Acres per farm	40	15	8.6	7.3	9.9	4.4	.6	1.5
Yield per acre	*Pounds.* 233	*Bushels.* 16.8	*Bushels.* 21.7	*Tons.* 0.79	*Tons.* 0.73	*Bushels.* 4.9	*Bushels.* 6.0	*Bushels.* 84.7

The average acreage of cotton per farm was 40 and of corn 15. None of the other crops averaged as much as 10 acres per farm. Cotton yielded 233 pounds of net lint per acre, corn 16.6 bushels, and oats 21.7 bushels. Oat and cowpea hay each approximated three-fourths of a ton per acre, while cowpea seed made 4.9 bushels and wheat 6 bushels per acre. Many other miscellaneous crops were also planted. The most important of these included cowpeas for hay and seed combined grown on 25 farms, and cowpeas with sorghum, grown on 10 farms. Some cowpeas were also planted in corn for seed and soil improvement. Besides these crops, small patches of sorghum were grown for sirup and stock feed; and sweet potatoes, Irish potatoes, and truck were planted both for home use and for a limited sale in the towns. A small amount of fruit was also produced, and practically every farmer had a garden.

The items of farm receipts (see fig. 4) were in the following percentages: Cotton, 79.8; corn, 3.3; oats and oat hay, 1.2; cowpeas, 0.8; miscellaneous crops, 1.6; live stock and live-stock products, 3.6; increase in feed and supplies, 1.1; and miscellaneous, 8.6. Four-fifths of the receipts came from cotton. Considering the farms on an owner basis,[1] the receipts per farm were $1,617, the expenses $1,060, and the farm income, $557. Deducting from the farm income 8 per cent on the investment (the current rate on borrowed money), the result is a minus labor income of $158.[2] Counting interest at 5 per cent, however, there is left a labor income of $110. After deducting the value of the operator's services from the farm income, the return on the investment was found to be 3.65 per cent. If, however, in addition to the operator's services, 8 per cent on the movable capital or the value of the live stock, implements, feed and supplies, and working fund, be deducted from the farm income,

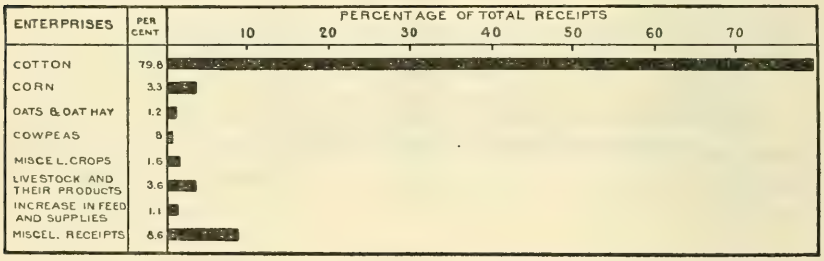

FIG. 4.—Farm receipts.

there is left a return of 2.99 per cent on the land and buildings. In other words, money invested in farm lands on this area, after paying all expenses, earned approximately 3 per cent on the investment.

The 112 farms used 337 head of work stock, or an average of 3 per farm. Usually there were as many families as mules, approximately an average of 3 families, including both white and colored, living on each farm.

COST OF PRODUCING CROPS.

The cost of producing the more important crops and the value of each were determined on the basis of acreages and yields shown in Table I. The cost of producing cotton, the major crop, was 10.89 cents per pound.[3] (See Table II.) The value was 11.5 cents, leaving a profit of 0.61 cent per pound. Corn cost $1 per bushel, but the value was less than the cost, or $0.983 per bushel. Oats and oat

[1] By "owner basis" is meant the consideration of a farm as though it were owned and operated by a single person. This applies to farms operated under any system of land tenure.

[2] Labor income: The farmer's earnings over and above expenses and interest on the money he has tied up in his business.

[3] Yields of cotton are expressed in this bulletin in the terms of net lint, while the costs and values include the bagging and ties, and are expressed in terms of gross lint. The bagging and ties are approximately 4 per cent of the weight of the gross lint.

hay, as they are grown, are very profitable crops. Cowpea hay cost $14.10 per ton, and was worth $19.17. Cowpea seed, grown after some other crop, was produced at an apparent loss. Wheat cost $1.34 per bushel, and was worth $1.24. In 1914 only 2 farms grew an acre or more of Irish potatoes, but as the farmers were increasing the acreage, records were obtained on 14 farms in 1915. The cost for that year was 52 cents per bushel, and the value $1.01.

TABLE II.—*Cost of producing crops in the Belton area compared with farm values.*

Item.	Cotton per pound gross lint.	Corn per bushel.	Oats per bushel.	Oat hay per ton.	Cowpea hay per ton.	Cowpea seed per bushel.	Wheat per bushel.	Irish potatoes per per bushel (1915).
Cost	$0.1089	$1.001	$0.433	$13.88	$14.10	$2.95	$1.34	$0.52
Farm value	.1150	.983	.657	23.97	19.17	1.98	1.29	1.01

Five-sixths of the cotton, four-fifths of the corn, and seven-eighths of the oats and oat hay were grown either by the owners of the land or under their immediate supervision.

TABLE III.—*Itemized distribution per dollar of cost of producing crops.*

Itemized costs.	All crops.	Cotton.	Corn.	Oats.	Oat hay.	Cowpea seed.	Cowpea hay.	Wheat.
Rent	$0.158	$0.141	$0.210	$0.173	$0.206	$0.142	$0.225	$0.187
Man labor	.378	.411	.304	.217	.234	.544	.243	.234
Interest on working fund	.013	.014	.011	.009	.012	.016	.009	.011
Mule labor	.210	.202	.242	.190	.205	.182	.264	.223
Implement cost	.030	.028	.036	.036	.034	.031	.043	.029
Seed	.028	.016	.008	.116	.119	.073	.212	.100
Fertilizer	.160	.160	.189	.211	.185	.....	.....	.159
Miscellaneous costs	.023	.028	.....	.048	.005	.012	.004	.057
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

TABLE IV.—*Itemized distribution of costs per unit of principal crops.*

Itemized costs.	Gross lint cotton per pound.	Corn per bushel.	Oats per bushel.	Oat hay per ton.	Cowpea hay per ton.	Cowpea seed per bushel.	Wheat per bushel.
Rent	$0.0154	$0.210	$0.075	$2.86	$3.08	$0.42	$0.25
Man labor	.0448	.305	.094	3.25	3.31	1.61	.31
Interest on working fund	.0015	.011	.004	.16	.13	.05	.02
Mule labor	.0220	.242	.082	2.85	3.61	.54	.30
Implement cost	.0031	.036	.016	.47	.58	.09	.04
Seed	.0017	.008	.050	1.66	2.91	.21	.13
Fertilizer	.0174	.189	.091	2.56	.....	.....	.21
Miscellaneous	.0030	.....	.021	.07	.06	.03	.08
Total	.1089	1.001	.433	13.88	13.68	2.95	1.34

The distribution of costs is shown in Table III. Taking the crops as a whole, man labor was the largest item of cost, 37.8 cents out of every dollar going for that purpose. Mule labor came next, 21 cents out of each dollar being charged to work-stock costs. Fertilizer and rent were practically the same; 16 cents was spent for

the former and 15.8 for the latter. Man and mule labor, fertilizer, and rent constituted most of the cost of production, the total expense of these items being 90.8 cents out of a dollar. The remaining 9.2 cents per dollar of cost was taken up as follows: Implements, 3 cents; seed, 2.8 cents; miscellaneous costs, 2.3 cents; and interest on working fund, 1.3 cents. The distribution of the items of cost for the principal crops is also shown in Table III. The total amount per crop unit chargeable to the various items of cost is shown in Table IV. This gives a further idea of how the costs are distributed among the various crops. The items of cost per pound of gross lint cotton are of most interest, man labor being 4.48 cents, mule labor 2.20 cents, fertilizers 1.74 cents, and rent 1.54 cents. Some of the notable influences that increase or decrease the cost of producing crops in the Belton area and the effect these costs have on the combination of enterprises will be shown in later discussion.[1]

METHODS OF MEASURING SUCCESS IN FARMING.

In showing the effect of one or more factors upon the success of a farm, some standard or standards must be used whereby the success can be measured. It has been quite well determined that no single standard can be used as an absolute measure. The viewpoint of those interested in the farm is not always the same, and what may be profitable to one may be unprofitable to another. A tenant, for example, may operate a farm that is profitable to him but which is a losing proposition to the landlord, or an operator may realize a high income by exploiting labor. Consequently more than one standard must often be used if a farm enterprise is to be judged correctly.

Some of the more important measures applicable in the Belton area are:

1. Farm income, which is the difference between receipts and expenses.

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[1] The items included in the costs were rent, man labor, interest on working fund, mule labor, seed, fertilizer, and miscellaneous costs. The renting value of the land covered the cost of the land, the building and fencing charges, insurance, and taxes. The man labor included paid or hired labor, and family, operator, and landlord labor. The interest on the working fund was the interest on the cash used to meet the current expenses. The work stock cost was the annual cost of keeping the work stock. The implement or machinery cost was the expense of using the implements for the year. The seed cost was the value of the seed used in planting the crops. The fertilizers included commercial fertilizers purchased and the barnyard manure applied. The miscellaneous costs were those peculiar to a crop, such as ginning, thrashing, etc.

In arriving at the costs, the number of productive days' work, both of man and mule labor, was ascertained for each crop, and the total for the farm. The total labor costs were then divided on the basis of the number of productive days' work on each enterprise. If, for example, the cost of man labor on a farm was $750, and the total number of productive days' work was 500, the cost per productive day was $1.50. If 300 days were used on cotton, 80 on corn, 30 on oats, 30 on cowpeas, 20 on live stock, and 40 on miscellaneous enterprises, the man-labor charge against the crops would be: Cotton, $450; corn, $140; oats, $45; cowpeas, $45; live stock, $30; and miscellaneous enterprises, $60. The labor on repairs and upkeep of the farm, which goes as nonproductive labor, or labor from which no direct income was received, was not recorded, but by spreading the labor costs on the basis of productive labor, this was cared for automatically. The mule-labor cost was spread in the same way as that of man-labor. The interest on the working fund was distributed on the basis of man-days and the implement costs on the basis of mule-days.

2. Labor income, which is what is left of the farm income after deducting a fair rate of interest on the investment.

3. The rate of income on capital after deducting a fair amount for the operator's services.

4. The cost of production per unit of measure.

5. Net income per mule. In this bulletin this will represent the net income of both the labor and the investment in the animal.

6. Yields per acre.

These measures and a few others will be used as occasion requires in the following pages. If a farm ranks high when measured by all of these, it safely can be regarded as an efficient and successful farm.

YIELDS.

As has previously been stated, yields are the most important factor in determining the success of the farms in this area. In reducing the cost per unit of product, yields exert a greater influence than any other factor.

Since cotton is by far the most important source of income on these farms, the acre yield of this crop is a very safe index of the efficiency of the farming. In Table V 110 of these farms were divided into groups based on the yield of net lint per acre. Nineteen of them had yields of 175 pounds or less. On these 19 farms the average cost of a pound of lint cotton was more than 15 cents. The income of these farms was not sufficient to pay expenses, so that after deducting the estimated value of the operator's services there was a net loss of 0.71 per cent on the investment. In the next group, consisting of farms on which the yield was from 176 to 225 pounds per acre, cotton cost 13.5 cents, and there was a profit of 2.54 per cent on the investment. As the yield increases the cost of lint cotton per pound decreases and the rate of income on investment increases. In the last group, where the yield is 326 pounds or more, the cost per pound falls to 9.6 cents, while the profit on the investment rises to 6.59 per cent.

TABLE V.—*Relation of yields of cotton to farm efficiency.*

Pounds of net lint cotton per acre.	Number of farms.	Average yield.	Per cent return on investment.	Cost per pound of gross lint cotton.
		Pounds.		
175 or less	19	159	[1] 0.71	$0.1554
176 to 225	24	198	2.54	.1353
226 to 275	34	247	4.45	.1170
276 to 325	19	305	6.12	.1108
326 or more	14	371	6.59	.0961

[1] Loss.

Yields of corn have much less influence on the per cent return on investment than does cotton, as corn is a minor crop. But the influence of yield on the cost of production is just as marked with

corn as it is with cotton. In Table VI the farms are grouped on the basis of yield of corn per acre. Twenty-five farms, producing 11 bushels or under per acre, grew corn at a cost of $1.48 per bushel. Twenty-three farms that made from 12 to 15 bushels per acre produced corn at $1.14 per bushel, or 25 cents per bushel less than the cost for the first group. Thus costs steadily decrease as yields increase. In the group with the highest yields, 19 farms, making 26 bushels or more per acre, the cost was but 77 cents per bushel.

TABLE VI.—*Relation of yield to cost of producing corn.*

Bushels of corn per acre.	Number of farms.	Average yield.	Cost per bushel.
		Bushels.	
11 or less	25	9.5	$1.48
12 to 15	23	13.5	1.14
16 to 19	19	17.5	.94
20 to 25	24	22.3	.86
26 or more	19	29.1	.77

Cotton did not pay the cost of production until the yield was 240 pounds of lint per acre and corn not until the yield was 17 bushels per acre. In other words, taking an average of the farms, cotton, when costs are computed by standard cost-accounting methods, was produced at a profit only when yields were more than 240 pounds per acre and corn when yields were more than 17 bushels per acre. This gives an idea of the yields farmers in this territory must obtain to make the production of these crops profitable.

The most striking reduction in costs with increase in yield is in the man labor and mule labor per crop unit. Rent, equipment, and seed costs also decrease with increasing yield, but these are of less importance in this area. On the other hand, fertilizer costs per unit are highest where the best yields are made. Man labor and mule labor, which on 112 farms constituted five-eighths of the cost of growing cotton and nearly one-half of the cost of growing corn, are the items in which the greatest difference occurs. The labor per acre increases with yields, but the labor per unit decreases, for, outside of harvesting, very nearly the same labor is required whether the yields are high or low; and the variation in mule labor, even in harvesting, is of little consequence.

HOW HIGH YIELDS ARE OBTAINED.

The weather during the growing season has much to do with the yield of any crop. But since all these yields were obtained in the same season and in the same locality, differences in the weather can not account for the differences in yield observed on these farms. The character of the soil is another important factor, but the soil is approximately of the same type on all farms included in this survey. The previous treatment of the soil differs widely from farm to farm

and undoubtedly accounts for much of the difference in yield on different farms. But in this study it was not practicable to secure the complete history of soil treatment for a series of years for each farm. This is not so unfortunate, however, as might at first appear, for it is fair to assume that the treatment of soil on each farm, during the year to which this study chiefly relates was, in general, the same that had been in vogue during several previous years.

Other factors having an important influence on crop yields are manure and commercial fertilizers, the succession of crops on the land, or the crop rotation, live stock, the kind of seed, and the methods of tillage used. So far as data are available concerning the effects of these factors they are given in the following pages.

One of the principal methods of maintaining or increasing yields in the Belton area is by the application of fertilizers. These consist principally of acid phosphate, cottonseed meal, nitrate of soda, and

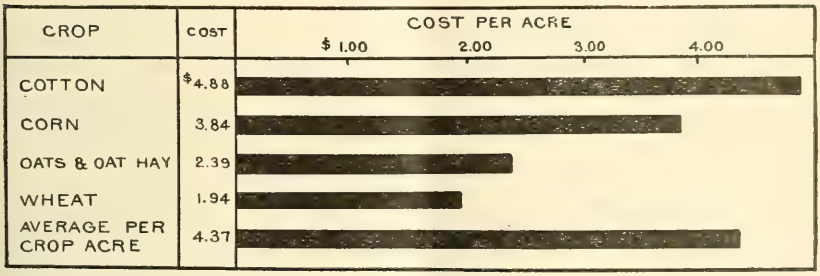

FIG. 5.—Cost of fertilizer per acre.

some form of potash salts, although some basic slag, sulphate of ammonia, fish scrap, blood meal, and tankage are used.

The common custom in applying fertilizers (see fig. 5) is to make the heaviest applications to cotton, the next heaviest to corn, to apply only small amounts to oats and wheat, and none at all to cowpeas. The average cost per acre of fertilizer applied in 1914 to the principal crops was: Cotton, $4.88; corn, $3.84; oats and oat hay, $2.39; and wheat, $1.94. The average for all crops was $4.37 per crop acre. Most of the barnyard manure, of which there was only a small quantity, was applied to cotton.[1]

[1] The economic reason for the heavier fertilization of cotton is its higher value per acre and the consequent greater profit from fertilizing. The average acre value of cotton and cotton seed in 1914 was $32.26, and of corn and corn fodder $19.92. Suppose, for example, an application of $4 worth of fertilizer per acre increased the yield of the crop by 25 per cent, which is not an uncommon occurrence, the gross value of the increase of cotton would be $8.07 per acre, leaving a margin of $4.07 as against an increase with corn of $4.98 and a margin of $0.98.

The relative prices of fertilizers and crops, particularly cotton, determine the amount of fertilizers it is profitable to apply. An increase in the relative price of fertilizers reduces the amount, while an increase in the price of crops increases it. The tables are based upon the 1914 prices of fertilizer. The use of fertilizers in South Carolina has enormously increased within the last quarter of a century, principally because of the higher prices received for cotton.

In Table VII the records are arranged in groups according to the amount of fertilizer applied to cotton, as measured by the cost of the fertilizer.[1] Beginning with a group of records where $3 worth or less of fertilizer per acre was used and the average yield was 200 pounds of lint per acre, the yields gradually increase as the amount of fertilizer used increases until an application of $7 or more of fertilizer is reached.

TABLE VII.—*Relation of the cost per acre of fertilizer applied to yield, and cost of cotton.*

Cost of fertilizer per acre.	Number of records.	Average cost of fertilizer per acre.	Yield of net lint cotton per acre.	Cost per pound of producing gross lint.
			Pounds.	
$2.99 or less	21	$2.26	200	$0.1142
$3 to $4.99	61	4.02	221	.1140
$5 to $6.99	44	5.62	272	.1028
$7 or more	23	8.64	276	.1217

But this increased yield did not always give a decrease in the cost of production. With the exception of the group of records using $5 to $6.99 worth of fertilizers per acre, there is not much difference in the cost per pound of lint in any of the groups. The earliness of the fall season was at least partially responsible for the high cost of production in the group using the most fertilizers. Heavy application of fertilizers causes late maturity, and in 1914 late cotton was cut short by the frost. It is probable that in most years the heavier application of fertilizers would have given the higher yields and that the cost of production would have been lower. The yields of corn increased (see Table VIII) from 14.2 bushels where less than $3 worth of fertilizer was used per acre to 21.8 bushels where $5 worth or more were used. There was no marked change in the cost per bushel, which was $1 in the group with the least fertilizer expense and $0.96 in the group with the highest.

TABLE VIII.—*Relation of cost of fertilizer applied to corn to yield, and cost of production.*

Cost of fertilizer per acre.	Number of records.	Average cost of fertilizer per acre.	Yield of corn.	Cost per bushel.
			Bushels.	
$2.99 or less	53	$1.75	14.2	$1.000
$3 to $4.99	63	3.74	18.4	.970
$5 or more	32	6.50	21.8	.959

In finding the effect of fertilizer on oats and oat hay (see Table IX) the two crops were combined. Yields can not be shown in this way,

[1] The application of fertilizer and the yields and costs were obtained for the individual crops cultivated both by the operator and the cropper. Hence Tables VII, VIII, and IX show more records than there are farms, as the crops grown by the operator alone and by the croppers are considered as distinct cases.

but the values are indicative. The cost of fertilizer per acre ran from nothing in 34 cases to an average of $5.01 in 20 cases. The highest value per acre and the greatest profit were with applications costing less than $2 per acre and averaging $1.42 per acre. The residual effect of the fertilizers applied to other crops is responsible for this showing. It is an indication that the best farmers fertilize cotton and corn heavily and oats lightly. Where such a practice is followed nothing but nitrate of soda is ordinarily used as a direct application to the oats. In normal times this costs from $1 to $2 per acre for the amount of fertilizer used in the most profitable group.

TABLE IX.—*Relation of the fertilizer practice to the cost, value, and profit per acre of oats and oat hay.*[a]

Cost of fertilizer per acre.	Number of records.	Average cost of fertilizer per acre.	Cost of crop per acre.	Value of crop per acre.	Profit per acre.
$0	34	$0	$8.88	$14.18	$5.30
$0 to $1.99	29	1.42	10.46	19.58	9.52
$2 to $2.99	20	2.36	12.56	19.03	6.47
$3	20	5.01	15.37	19.33	3.96

[a] The fertilizers applied to previous crops largely determine the fertilizer applied to oats. Heavy applications to previous crops followed by moderate applications to oats constituted the most profitable practice.

Another way by which increased yields are obtained in the Belton area is by planting cowpeas. The cowpea is the only legume that is used extensively. It is planted principally after oats, but also in corn for soil improvement and for seed. Farmers in this section frequently furnish land rent free to croppers and tenants for planting cowpeas, it being assumed that the soil improvement resulting from growing the cowpeas is worth the use of the land.

In Table X the farms are grouped on the basis of the per cent of the crop area planted in cowpeas. The cowpeas include those planted either separately or with sorghum and millet. It can easily be seen from this table that the higher the percentage of crop land planted in cowpeas the higher are the yields of cotton and corn. This is an indication of the great value of the cowpea in obtaining yields.

TABLE X.—*Relation of the per cent of crop area planted in cowpeas to the yield per acre of cotton and corn.*

Per cent planted in cowpeas.	Number of farms.	Yield.	
		Net lint cotton.	Corn.
		Pounds.	*Bushels.*
5 per cent or less	38	222	15.6
6 to 10 per cent	33	252	18.0
11 per cent or more	39	277	20.8

The preparation of the land and the cultivation of the crops are other factors affecting yields. These depend on the labor devoted to tillage and the quality of the work. Labor used is frequently an individual problem or a matter of judgment. The amount of work that can profitably be done in preparing land for planting and in cultivating crops varies with the condition of the land, the prevalence and kinds of weeds present, the earliness or lateness of the season, the rainfall, etc. For this reason any study based on the labor devoted to tillage per acre may be misleading. It may be noted, however, that the farmers who used above the average amount of man labor and mule labor, both in preparing the land and in cultivating the crop, produced the most cotton and corn per acre.

The quality of the tillage depends upon both the character of the implements used and the efficiency of the men and mules operating them. A careful man with a strong mule may do better work with a one-horse plow than an inefficient man using two small mules and a two-horse turnplow. On the whole, however, farmers using good implements and good work stock made the best yields, even where the same amount of fertilizer was used. More improvement can be made by increasing the quality of the tillage than by increasing the labor devoted to it. It is not possible, however, to increase the yields in this region as much by improving the tillage as by increasing the application of fertilizers and by growing more legumes.

Live stock, because the number kept is small, does not have a marked effect on yields in this area. On the farms that keep the most stock, however, there is a tendency to devote the poorer grades of land to pasture and to plant more cowpeas. This leaves a better grade of land for crops, which, with the improvement from the pasture and cowpeas upon the poorer land and the manure from the live stock for the crop, gives better yields than are made on the average farms.

The variety of seed planted also has a direct bearing on yields. Farmers who planted Cook and Cleveland Big Boll cotton (see Table XI) obtained the best yields. Marlboro Prolific was the best-yielding variety of corn. It is noticeable that the farmers who take an interest in the kind of seed they plant are the ones who make the best crops. Farmers whose interest in the seed is so little they do not know the variety they plant are the ones who have the poorest yields.

TABLE XI.—*Varieties and yields of cotton and corn.*

Variety of cotton.	Number of farms.	Yield of net lint per acre.	Variety of corn.	Number of farms.	Yield per acre.
		Pounds.			*Bushels.*
Cook	35	248	Marlboro Prolific	36	19.9
Cleveland Big Boll	24	242	Not specified	55	16.3
Not specified	22	230			
Christopher	11	228			

Yields in this area could be increased by the use of lime, but comparatively little has been used. Winter cover crops of crimson clover, burr clover, and rye are advisable, but these crops are not grown to any considerable extent for this purpose. Planting vetch with oats for hay is profitable, but thus far only a few farmers do this.

ACRES PER WORK ANIMAL AND SIZE OF FARMS.

In the management of a farm the business should be so adjusted that the unit of organization can be utilized at its optimum capacity. In the Belton area, where cotton is the main crop, the work animal, usually in this case the mule, is the pivot around which the unit of organization is built. Usually there is one mule for each family, as one mule can do the plowing for all the crop the average family can handle, and one-horse implements are the kind commonly used. The number of acres per work animal is therefore an indication of the utilization of the labor and equipment and of the efficiency of the farm organization.

ACRES PER WORK ANIMAL.

The most profitable acreage of crops per work animal in the Belton area can be closely approximated from the data in Table XII. The table shows that as the crop-area per mule increases, profits increase until an acreage of 20 to 23 acres is reached. Individual cases such as might occur when an old man or a boy does the plowing or when a poor mule is used may make smaller acreages more desirable; the data in the table represent the averages for the area. The rate of income on the investment, 4.32 per cent, and the income per mule, $422, are both highest in this group. When the acreage became higher than this the farms became less profitable.

TABLE XII.—*Relation of crop area per work animal to farm efficiency.*

Number of crop acres per work animal.	Number of farms.	Per cent of return on investment.	Income per mule.
11 or less	7	2.64	$238
12 to 15	13	3.30	267
16 to 19	33	3.67	324
20 to 23	28	4.32	422
24 to 27	23	3.62	396
28 or more	6	2.86	386

It is of interest to note in this connection that for each acre per mule above or below 21.5 the effect on profits was the same, on the average, as a reduction in yield of 8 pounds of lint cotton per acre.

SIZE OF FARM.

For many reasons it is easier to get efficient organization on large farms than on small ones. Suppose that, in a given type of farming, from 20 to 23 acres is the most profitable acreage per work animal, and the size of farm is 200 acres. Then either 9 or 10 work animals could be used efficiently. With 9 mules we have 22.2 acres per mule, while with 10 we have 20 acres per mule. But suppose the farm contains only 30 acres of crop land. In this case the problem of utilizing the work stock to best advantage is difficult, for 30 acres is too much for one mule and not enough to keep two mules properly occupied.

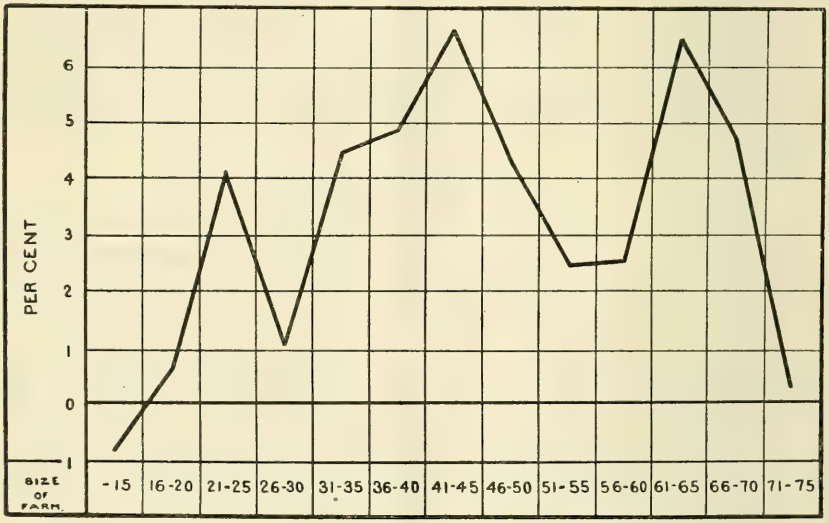

FIG. 6.—Relation of size of farm to per cent return on investment.

Let us see if we can find the sizes of farms as now organized which are most profitable in the Belton area. This can be done by placing the farms in groups differing in size by 5 acres and noting the per cent return on the investment and the income per mule in the various groups. In Table XIII the farms are grouped in this manner. The first group consists of two farms of less than 15 acres each, which lack 0.41 per cent of paying interest on the investment, and have an income of only $221 per mule. The profits increase as the size increases until the size is 21 to 25 acres, after which profits drop. They increase again and reach another high point at 41 to 45 acres. After this profits decline again, then increase and reach a third high point at 61 to 65 acres, following which there is another decline. Farms of more than 75 acres were not used in the table, as they were not sufficiently numerous.

TABLE XIII.—*Relation of size of farm to efficiency.*

Size (acres).	Number of farms.	Group.	Per cent of return on investment.	Income per mule.
Less than 15	2	C	[a]—0.41	$211
16 to 20	10	B	.68	288
21 to 25	11	A	4.13	341
26 to 30	6	B	1.08	258
31 to 35	7	C	4.32	311
36 to 40	11	B	4.80	352
41 to 45	9	A	6.74	412
46 to 50	13	B	4.22	299
51 to 55	7	C	2.43	315
56 to 60	2	B	2.52	239
61 to 65	7	A	6.63	398
66 to 70	4	B	4.70	457
71 to 75	3	C	.23	304

[a] Loss.

This table illustrates an application to farm-management studies of what is known as the law of recurring efficiency. As the size of the business increases (see fig. 6) a point is reached where the single unit of organization can be utilized most profitably. For some distance above this point the size does not permit the proper adjustment of the unit, and the business loses efficiency. As the size keeps on increasing another point is reached where two units fit in well, and a high point of efficiency is again reached. These high points, or the periods of efficiency on these farms, were on farms having 21 to 25, 41 to 45, and 61 to 65 acres per farm. Comparing these data with the most profitable acreage per work animal, it can be seen that these sizes are sizes for well-organized one, two, and three mule farms. Farms that were too large or too small for a given number of mules were less profitable. There were only a few farms in each of the groups in this table, but the influence of efficient sizes is so strong that a large number of farms is not required to discern the effect.

We may now take those farms having the more favorable sizes, namely, those of 21 to 25, 41 to 45, and 61 to 65 acres, and compare them still further with those having less favorable sizes. In Table XIII the groups of farms are labeled A, B, and C, as an indication of the favorableness of size, the A groups having the most favorable and C the least favorable size. By combining all the A groups into one, the B groups into another, and the C groups into a third, the effect of the favorableness of size can be clearly seen. The farm income, the labor income, the per cent return on the investment, and the income per mule (see Table XIV) are all highest on the farms having the more favorable sizes. In the A groups the farm income is 48 per cent higher than, and the per cent return on the investment more than double, that in the C groups.

TABLE XIV.—*Relation of favorableness of size of farms to efficiency.*

Size group.	Number of farms.	Investment.	Farm income.	Labor income allowing on investment—		Per cent return on on investment.	Income per mule.
				8 per cent.	5 per cent.		
A	27	$5,487	$501	$62	$227	5.68	$379
B	46	5,452	374	− 62	102	3.52	315
C	19	5,776	339	−123	53	2.45	301

In Table XV it is seen that in every case the crops were produced at the lowest cost on the farms having the more favorable sizes. In addition to this, the average value of the dwelling was highest on these farms, and not only were the dwellings the most valuable, but these farms could also best afford them, for the value was only one and one-half times as great as the farm income, while on the farms of the groups having the least favorable sizes, the value of the dwellings was twice that of the farm income.

TABLE XV.—*Relation of favorableness of size of farm to cost of producing crops, and ratio of value of dwelling to farm income.*

Size group.	Cost per unit.					Average value of dwelling.	Ratio of value of dwelling to farm income.
	Cotton per pound, gross lint.	Corn per bushel.	Oats per bushel.	Cowpea hay per ton.	Wheat per bushel.		
A	$0.1033	$0.914	$0.389	$16.77	$0.829	$776	1.549
B	.1162	1.089	.400	18.05	1.335	668	1.786
C	.1149	1.118	.509	16.71	1.895	689	2.032

Farms having the more favorable sizes had a lower cost per productive man day and mule day of work, and also higher yields of crops than the others. (See Table XVI.) Each productive man day's work cost $1.18 in the A groups as compared with $1.30 in the C groups. The cost per productive mule day in the A groups was $1.34 as compared with $1.36 in the C groups. These differences were not great, but they show greater efficiency in the farms with the favorable sizes.

TABLE XVI.—*Cost of man and mule labor and yields of cotton and corn per acre by favorableness of size of farms.*

Size group.	Cost per man day.	Cost per mule day.	Yield per acre.	
			Net lint cotton.	Corn.
			Pounds.	*Bushels.*
A	$1.18	$1.34	268	19.0
B	1.27	1.37	241	18.1
C	1.30	1.36	235	16.4

The most noticeable difference is in the yield of crops. Cotton made 268 pounds of net lint per acre on farms having the more favorable sizes and 235 pounds on those of the C groups, while corn made 19 and 16.4 bushels, respectively. Not only do the farms with the more favorable sizes handle the labor more efficiently, but since the acreage is such that labor is utilized to good advantage, the crops were properly tended and good yields resulted. It is also noticeable on these farms that where a man is efficient in one thing he is also likely to be efficient in others. When a farmer has the foresight and ability to adjust the size of his farm so that the labor and equipment have a high degree of efficiency, he will also usually have the ability to secure yields that are above the average.

Handling the farm in such a way that the unit of organization can be used at its optimum capacity is therefore one of the important factors in determining the success of a farm. The farmer who has an acreage too small for one mule should rent, clear up, or buy more land. Or, if he has too much for one and not enough for two, say 30 acres, for example, he should either rent out some land, retaining enough to make an efficient size for a one-mule farm, or in some way add to his acreage sufficient to make a good two-mule farm. A man with 55 acres of crop land has too much for two mules and not enough for three, but if he would rent out 10 acres and make a two-mule farm, or rent, buy, or clear up 10 acres more and run a three-mule farm, his profits would be greater. Another way of handling such situations as this is to plant certain more or less intensive crops. If the acreage per mule is too small, one may plant crops requiring more labor; or if the acreage is too large, a larger acreage of extensive crops like corn may be planted. But where cotton is the predominating crop, neither of these methods is so satisfactory or so profitable as adjusting the size of the farm to give the optimum acreage per mule.

The relation of size of farm to efficiency in the Belton area can also be studied by comparing the farms having different numbers of work animals per farm, for here size is commonly designated thus. In Table XVI and figure 6 it can be seen that farms that had from 41 to 45 acres, or a good size for two mules, were for their size more profitable than the 1-mule and 3-mule farms. In comparing farms of different sizes one difficulty is that the small farms frequently have unfavorable acreages for the efficient use of work animals. In fact this is one of the weak points in the organization of small farms. For that reason, in order to make a better comparison, farms having only 17 or more acres per work animal are used in Table XVII. In this grouping, also, farms using two head of work stock were most profitable. The 2-mule farms had the highest per cent return on the investment and made the most cotton per acre, though the yields of

corn were not so good as in the group having four or more mules. Evidently a two-mule farm with the proper acreage per work animal is the best size of farm for this community.

TABLE XVII.—*Relation of number of work stock per farm, on farms having 17 or more crop acres per work animal, to per-cent return on investment and yield of crops.*

Number of work stock per farm.	Number of farms having 17 or more acres per work animal.	Per cent return on investment.	Yield per acre.	
			Net lint cotton.	Corn.
			Pounds.	*Bushels.*
1	17	3.02	220	18.6
2	37	4.82	246	16.6
3	13	3.73	233	17.2
4 or more	17	3.32	242	19.6

There are several reasons for the relatively high efficiency of the two-mule farm. The operator himself usually works, and he takes more interest in the laborer and the laborer in him than where there is a larger number of laborers on the farm. Frequently, also, the second mule is worked by the operator's son, and all the labor is performed by a single family. This tends toward increasing the efficiency of the labor. Furthermore, the two-mule farms can use two-horse implements, giving a more economical use of man and mule labor. Frequently one man with two mules can do the plowing and cultivating while another man is doing handwork. Also, the work animal is not necessarily idle when the plowhand is doing handwork, as it is on a one-mule farm.

A high degree of managerial skill is not needed on a two-mule farm, as the business is not complicated. It was noted in this survey that the value of the operator's services, on the average, did not increase until farms using more than two mules were reached, showing that on this size of farm managerial ability was not of such importance as to command a premium.

COMBINATION OF ENTERPRISES.

In newly settled areas, where agriculture is largely in the experimental stage, the combination of enterprises, or the type of farming, is the factor that usually has most to do with variation in farm profits. But as the agriculture grows older fewer mistakes are made in this respect, for the farmer who fails to include the most profitable enterprises in the organization and give each its proper weight soon finds his business so unprofitable that he must either change his methods, quit farming, or be content with a poor living. For this reason, in any old established area where the standard is already high there is not as much opportunity to improve the efficiency of farms by changing or adjusting the combination of enterprises as there is by increasing

yields or by organizing the farm so the unit of organization can work at its optimum capacity. On the farms visited in this survey the combination of enterprises in increasing the per cent return on the investment is now only one-fourth as important as yields and only three-fourths as important as the crop area per work animal. However, because of the importance of the combination of enterprises in the past, and the continual efforts that will be made to find a more profitable type, this factor will be discussed at some length. Furthermore, the introduction of a new crop or a sudden change in economic conditions may make the combination of enterprises the most important factor in determining success.[1]

CHANGES IN THE TYPE OF AGRICULTURE IN ANDERSON COUNTY.

Within the last three-quarters of a century Anderson County has changed from grain and live-stock farming to cotton farming. In 1840 grain and live stock predominated even to a greater degree than cotton does to-day. In Table XVIII the census data showing changes in the agriculture from 1840 to 1910 are given, and in Tables XIX and XX the relative importance of the principal crops and the various kinds of livestock are shown. More of the land is now in cultivation than in 1840, primarily because of the increase in population. Of the land devoted to cotton, corn, oats, and wheat in 1840, cotton was planted on 12.8 per cent, corn on 69.9, oats on 7, and wheat on 10.3 per cent. In 1910 cotton occupied 63.3 per cent, corn 25.9, oats 8.4, and wheat 2.4 per cent of the total land devoted to these four crops. The positions of cotton and corn have been reversed, while oats on the average occupies about the same position and wheat a much lower place than it did in 1840. The greatest change in the type of agriculture took place from 1870 to 1880, when the percentage of land planted in cotton more than doubled, increasing from 21.7 to 43.5 per cent, while corn decreased from 61.8 per cent to 35.5 per cent.

TABLE XVIII.—*Census data showing changes in the agriculture of Anderson County, S. C., 1840 to 1910.*

		1840	1850	1860	1870	1880	1990	1900	1910
Improved acres in farms		.....	178,455	133,249	96,228	192,820	220,406	246,933	260,546
Per cent of land in farms improved		.....	38.7	31.1	23.9	43.0	50.3	57.0	58.6
Cotton	acres	.....	.....	.....	.....	61,060	100,960	123,992	133,343
	bales	4,698	5,003	3,758	5,274	21,897	41,530	41,679	55,881
Corn	acres	.....	.....	.....	.....	49,953	58,055	58,507	54,489
	bush	698,519	820,549	579,682	409,688	492,646	547,217	596,140	663,264
Oats	acres	.....	.....	.....	.....	12,776	19,288	8,862	17,804
	bush	69,988	209,067	28,761	34,213	94,613	163,231	76,990	277,702
Wheat	acres	.....	.....	.....	.....	16,754	14,558	17,164	4,891
	bush	106,105	120,382	95,065	77,169	101,950	81,818	118,010	38,947
Horses and mules		5,626	5,796	4,817	3,946	5,585	6,761	8,515	10,742
Cattle		18,499	19,215	17,398	11,337	11,816	13,139	14,876	18,530
Sheep		10,387	13,135	11,951	10,534	3,698	1,730	602	245
Swine		36,381	43,242	26,058	16,167	10,695	12,178	12,360	11,163

[1] An illustration of the latter is the indigo industry in South Carolina. When a substitute for indigo was discovered indigo farming immediately became unprofitable. increasing the yield would have been of no avail. The big problem of the farmers was to find a new combination of enterprises suitable for the conditions, and until this was done the farms remained unprofitable.

Cattle have barely held their own in Anderson County, there being 18,499 in 1840 and 18,530 in 1910. As compared with population, they have decreased in relative numbers and importance. Sheep have declined from 10,387 in 1840 to 245 in 1910, while in the same period hogs declined from 36,381 to 11,163. These figures for live stock in 1840 are hardly comparable with the 1910 census, however, as the last census was taken in April, while in other years the census was taken in June, thus including a larger number of young stock.

TABLE XIX.—*Percentage of area devoted to principal crops, by decades, Anderson County, S. C.*

Crop.	1840[a]	1850[a]	1860[a]	1870[a]	1880	1890	1900	1910	112 farms, Belton area, Anderson County, 1914.
Cotton	12.8	10.6	12.7	21.7	43.5	52.3	59.5	63.3	63.1
Corn	69.9	63.9	72.2	61.8	35.5	30.1	28.1	25.9	23.6
Oats	7.0	16.3	3.6	5.1	9.1	10.0	4.2	8.4	12.1
Wheat	10.3	9.2	11.5	11.4	11.9	7.6	8.2	2.4	1.8

[a] Acreages of crops were not given in the census of 1840, 1850, 1860, and 1870. These were estimated by taking the average yield for 1880, 1890, 1900, and 1910, and dividing it into the total yield of the years when acreages were not given. From these estimates the percentages in Table XIX and the acres per animal in Table XX were computed for the farm by decades.

Though the agriculture of the county made large developments from 1840 to 1910, live stock either declined or was at a standstill. Consequently, of more significance than the change in the number of live stock is the decline during this time in the importance of livestock as related to the crops. This can best be shown by the number of animals of a specified kind there were for each 100 acres of land planted to cotton, corn, oats, and wheat in each decade. In 1840 there were 19.2 head of cattle, 10.9 head of sheep, and 35.8 head of swine for each 100 acres of these four crops. In 1910 there were 8.8 head of cattle, one-tenth of a sheep, and 5.3 head of swine for the same acreage. Stated in another way, in 1910 cattle as related to the crops were only 46 per cent, sheep 1 per cent, and hogs 14 per cent as important as they were in 1840, making no allowance for possible discrepancies in the census reports. The greatest falling off in live stock was from 1870 to 1880, or in the decade when there was the largest increase in cotton and the largest decrease in corn. The decline in hogs has followed the decline in corn and the increase in improved land, as the hogs were dependent upon corn and range for support.

TABLE XX.—*Number of specified animals per 100 acres of land planted in cotton, corn, oats, and wheat in Anderson County, S. C., 1840 to 1910.*

	1840	1850	1860	1870	1880	1890	1900	1910
Cattle	19.2	15.6	22.7	17.8	8.5	6.8	7.1	8.8
Sheep	10.9	10.6	15.4	16.7	2.6	.9	.3	.1
Swine	38.5	34.5	33.3	25.6	7.6	6.3	5.9	5.3

COMBINATION OF ENTERPRISES SUITABLE FOR THE BELTON AREA.

CROPS.

The cost of producing crops is an indication of the type of farming that should be followed. With costs computed by standard cost-accounting methods, cotton was produced at a profit. Corn and wheat were produced at an apparent loss, but oats and cowpeas were grown at a profit. To understand fully the relation of these costs to the type of farming, however, two things must be borne clearly in mind. One is that if the labor and equipment were not used for the minor crops they would otherwise be idle. In computing these costs, labor and equipment were charged at their full value against the minor crops, but nevertheless it would have been wise to use them in growing these crops even though they earned only a part of their real value, for otherwise they would have earned nothing. For this reason, although the indicated cost of producing corn, when computed by standard cost-accounting methods, is more than the value, it is nevertheless profitable to grow some corn when the farm is considered as a whole. In fact, by growing the minor crops, even though they do not give a full return for the labor and equipment, it is possible to grow the major crop at a lower cost than otherwise, for in this way the charges against it for these items are reduced. If, however, the major crop can not make up for the lower return on the minor crop, the system of farming will become unprofitable.

The second point in regard to type to be considered is that a crop may be produced profitably for home consumption, but when sold in the markets of the world it may be unprofitable. The reason for this is that as long as crops are produced for home consumption they have a value equal to the retail price, but when any more than this is grown the value of the surplus immediately falls to the wholesale price, except for a limited amount that may be retailed locally. This may be illustrated by oats, which were produced in the Belton area at a cost of 43.3 cents per bushel. Oats shipped into Belton come from the Middle West, and there are dealer's, elevator, sacking, and freight charges attached to the prices received by the grower. As this is written there is a difference of 20 cents per bushel in the wholesale price of oats at Champaign, Ill., and Columbia, S. C., the price at the former place being 38 cents and at the latter 58 cents. By the time the oats pass through the local dealer's hands at Belton and reach the farmer at a retail figure the price is 65 cents per bushel. So long as the farmer in the Belton area can grow oats for 43.3 cents per bushel it is cheaper for him to produce the oats needed for his farm than it is to buy them, and he can even to a limited extent compete in the local market with the middle western grower. But when he sells outside the local market and has to pay dealer's, bagging, and shipping charges, or when he produces so much oats that the straw

can not be utilized, so that the credit of the straw against the cost of production declines, which in reality increases the cost per bushel, he can not compete with the middle western man who produces his oats at a lower cost. The ability to grow minor crops with labor and equipment that would otherwise be unemployed, and the fact that these crops when purchased are bought at a retail price and when sold are sold at a wholesale price, establish very definite limits to the extent to which the minor crops can be profitably grown. As soon as the farm and possibly a limited local market are supplied the profitable outlet for the minor crop is gone. With cotton, the major crop, it is otherwise. Cotton is sent into the markets of the world, where it can meet competition with cotton from other countries. Consequently it has a wide range of adaptability on these farms, while with the minor crops the limits, as just shown, are well defined. This makes it profitable for these farms to produce feed crops necessary for home consumption, but if any considerable amount more or less than this is grown there will be a decline in the profits. It was noticeable from a study of individual cases that farms that produced the feed crops for home use and had just enough to insure this supply were the ones that made the most money. Those that purchased feed were the least profitable.

We may see from Table XXI how the crops are distributed on farms having different acreages per work animal. In the group planting 11 acres or under per mule, the percentage of land in cotton was lowest and the percentage in feed crops highest. The per cent of land planted in cotton increased and that in feed crops decreased as the acres per work animal increased until the group planting from 20 to 23 acres was reached. With acreages higher than this the relative distribution of crops was about the same. This table shows the natural tendency of farmers is to produce the feed crops before planting cotton.

TABLE XXI.—*Relation of crop area per work animal to distribution of crops.*

Crop acres per work animal.	Average crop acres per work animal.	Acres per work animal.				Per cent of crop area planted in—			
		Cotton.	Corn.	Oats and oat hay.	Cow-peas.	Cotton.	Corn.	Oats and oat hay.	Cow-peas.
11 or less	10.0	5.2	3.5	1.3	0.9	50.9	34.9	14.2	11.0
12 to 15	13.8	8.1	3.9	1.8	1.2	58.1	27.7	14.4	9.9
16 to 19	18.0	10.3	5.0	2.5	1.7	58.6	24.6	15.8	10.5
20 to 23	21.5	14.2	5.5	2.4	1.6	64.9	23.7	11.7	8.4
24 to 27	25.3	16.0	5.8	3.0	2.5	64.9	20.5	11.8	9.2
28 or more	32.5	20.1	8.0	4.1	3.2	63.2	24.6	11.9	9.4
All classes (110 farms)	20.5	12.6	4.9	2.5	1.8	61.5	23.9	12.2	8.8

In determining the combination of crops that is most profitable for the individual farm the labor supply must be taken into consideration. Where there is an abundance of labor needing employment,

cotton has an advantage, for it will furnish more profitable work per acre than corn or oats. If, on the other hand, the labor supply for a given acreage is scant, then, from the standpoint of the profits of the whole farm, the acreage of the more extensive crops should be increased. Under average conditions, however, the farms should grow the feed crops first and then plant all the cotton that can be handled.

Under normal conditions cotton is the crop that exerts the greatest influence on the profits of these farms. The amount of cotton produced per work animal, which is a result of both yields and acreage, is the best index of the efficiency of these farms. In Table XXII the farms are grouped on the basis of the number of bales produced per work animal. Twenty-seven farms that produced less than 5 bales per mule barely paid expenses and made only 0.5 per cent on the investment and $212 per mule. More cotton meant more profit, and on the 35 farms in the highest group, producing 7 bales or more per work animal, the return on the investment was 6.24 per cent and the income per mule $475. The total production of cotton, as can be seen from the last two columns of the table, was due both to the yields and acreages per work animal.

TABLE XXII.—*Relation of the number of bales of cotton produced per work animal to the returns of the farms.*

Number of bales per work animal.	Number of farms.	Per cent returns on investment.	Income per mule.	Crop area per work animal.	Yield of net lint per acre.	Acres of cotton per work animal.
				Acres.	*Pounds.*	
Less than 5	27	0.50	$212	18.3	195	9.1
5 to 5.99	20	1.92	273	19.4	247	11.4
6 to 6.99	28	4.66	334	20.8	249	12.9
7 or more	35	6.24	475	23.2	283	14.9

It is evident also from a study of the cost of production that more oats and cowpeas and less corn (see Table II) would increase the profits of the farms in the Belton area. Oats were produced at a profit, and corn, when costs are computed by standard cost-accounting methods, was produced at a loss. Furthermore, by planting oats the land is available for cowpeas, which, as has been shown, is an important factor in obtaining yields. Apparently farmers are realizing these things, for from 1900 to 1910 (see Table XVIII) the acreage planted in corn in Anderson County decreased, while the acreage of oats doubled.

LIVE STOCK.

The status of live stock on these farms is an indication of the live stock that should be kept. There was an average of 4.7 head of cattle of all kinds per farm owned by the operators on the 112 farms included in the survey of the Belton area. On January 1, 1915, the average farm value of all cows was $30.40 per head; of heifers a year old or older, $13.65; and of calves that would be

yearlings in the spring, $4.98. These values indicate that there were either too many cattle, the quality was very poor, they were not properly distributed on the farms, or they were not of the right kind; that is, too many steers were kept in place of cows. Most of the cows having a considerable percentage of Jersey blood in them would, if bred to good bulls, soon produce high-grade dairy cattle well adapted to the region. It is utterly impossible, however, to raise calves to 9 months old for $4.98, and many times it is good luck to the farmer, as stated by many of them, if the calf dies or is killed when it is born. There is practically no market for veal calves in this area, but if good bulls were used, a better grade of cattle, that could be raised profitably, would soon be obtained.

There were three hogs of all kinds per farm on hand January 1, 1915. Pigs 3 months old were commonly valued at $3 to $5 apiece. One reason for the high price of pigs was that many farmers did not want to keep a sow, preferring to buy pigs of some one who raised them to sell. Cotton-mill employees also bought pigs, thereby increasing the demand. With the economic situation, existing at the time of this survey, conditions on the farms are not favorable for the growing of hogs except for the home meat supply. This is shown by the fact already stated that, as related to crops, hogs occupy only 14 per cent of the place in Anderson County that they did in 1840. One unfavorable condition is the high cost of producing corn and the consequent small amount that is now grown. Hogs went out of Anderson County as corn went out. Another drawback is that the soil is not suitable for pasturing peanuts, as is done in some parts of the coastal plain section of the South where there is less clay in the soil, as the rooting of the fields in wet weather puddles the soil and puts it in poor condition for future crops. A third reason is that cowpeas, which are used in growing hogs, do not do as well as in the lower part of the State. Hogs, however, sufficient for home consumption are profitable on these farms.

The conditions in this area are also unfavorable for the production of beef cattle. One proof of this is the remarkable decline in the relative importance of cattle to crops within the last three-quarters of a century. The high cost of producing feed is another. The production of beef cattle divides itself into two phases—one the production of stockers and feeders, and the other the finishing of the cattle for the market. The former requires cheap range, and the latter cheap concentrated feed. In Anderson County the value of the land is high as compared with the range or grazing it affords. Including woodland and waste land, the average value of the 112 farms surveyed was $57.06 per acre, when only 52.8 per cent of this was in cultivation, most of the remainder being in woodland. With this

price of land and the quality of grazing the pastures in this area afford, stockers and feeders can not be profitably produced except on very limited areas of waste land, or on land that is too poor for growing crops profitably, yet which will furnish some grazing. Cottonseed meal and hulls have been used for fattening cattle in South Carolina, but even when silage was added to the ration, this method of fattening cattle appears to have been not entirely satisfactory. When meal was worth $20 per ton and hulls $4 per ton, and feeders could be bought cheaply in the mountains of North Carolina and Tennessee, many farmers throughout the State fattened cattle for the market, but as other cattlemen from other parts of the country competed for the feeders, and the price of meal and hulls went up, South Carolina farmers went out of the business, and only a small percentage of the number of cattle fattened in this way 10 years ago are now fattened in the State. Farmers in the corn belt of the Middle West, where the cost of producing corn and hay is much lower than it is in the Belton area, have an advantage in fattening cattle over the Anderson County farmer, which, under the conditions, can not be overcome. Another factor that is against the growing of beef cattle in this area is the density of the population. There is already one family for less than 25 acres of cultivated land. If the family makes a living, the farming must be intensive. Beef-cattle farming, particularly raising stockers and feeders, is an extensive kind of farming requiring comparatively much land and little labor. If such a type were established in the Belton area, much of the labor would be thrown out of employment. These considerations explain why beef cattle are not found on these farms and furnish substantial proof that conditions are not favorable for the production of beef cattle in this area.

The number of sheep in the entire county in 1910, according to the census report, was only 245. Consequently, this branch of live stock need not be discussed, except to say that the same competition of the western ranges that drove sheep out of New England also drove them out of South Carolina. However, the conditions which caused the abandonment of sheep in this county several years ago are now changed, and it is well worth considering whether in view of the shortage in wool and mutton it would not be profitable to farm owners to have small flocks of sheep as a part of the system of diversified farming. A small flock of sheep, like a small flock of chickens, can be maintained on the average farm with very little outlay for maintenance.

The average number of chickens per farm was 41. There were a few farms with more than 100 hens. Some of the large flocks were profitable, and some were not, the small number of eggs obtained

annually per hen being the chief cause of losses. Most farms raised chickens for home use only, as under present conditions there is only a very limited market for the surplus products. The number of chickens per farm in any region is usually influenced by the type of agriculture. Chickens are kept largely as scavengers, and the section that produces grain and live stock is the one where the most chickens are found. On most farms of a general type, when chickens have to be fed to any considerable extent, they become unprofitable unless handled with the skill of a professional poultryman. In Anderson County, where so high a percentage of the land is planted in cotton, and where such a comparatively small amount of grain is grown and not much live stock kept, it does not take many chickens to consume the waste, and when more than the number needed for this is kept, only a few farmers find them profitable.

There are evidences on every hand that although live stock has and should have an important place on the farms for home use, the county as a whole is not well adapted to live-stock production. It takes feed to grow live stock. The kind of live stock grown on the farms of the Belton area is an indication of the shortage of the feed supply and the high cost of producing feed in this region. The work stock are mostly mules, the cattle have a high percentage of Jersey blood, and the chickens are small sized and of the egg-laying strains—all facts attributable to the limited supply of feed. Regions that have an abundance of feed use horses instead of mules, produce as a rule cattle of larger frame than the Jerseys, and grow chickens of the meat-producing strains. In few sections of the country is less feed wasted than in such regions as the Belton area. Fodder was "pulled" on every one of the 112 farms surveyed and from practically all of the corn that was grown. Any kind of forage that can not be profitably harvested is pastured some time during the year. One main cause, therefore, of the status of live stock on these farms is the short supply of feed and the high cost of producing it.

The keeping of live stock on these farms is, like the growing of feed crops, profitable only when primarily for home consumption. Dairy and poultry products are substantial articles of diet that no farmer can well afford to be without, even though the cost of production is high. Usually, however, even on cotton farms, some of the land pastured or the feed used would be wasted were it not for cattle. A few hogs can also be profitably kept, but the number is not large.

A few farms are apparently finding dairying in a small way profitable under their conditions. On these farms in most cases the families are large, and the work is done by the operator and his family. The family labor is comparatively cheap, which makes it easier to secure a profit from cows. Hired labor would make unprofitable some of the cows on the farms where they are now profitable.

SPECIAL FARMS AND NEW CROPS.

Some mention should be made of a few farms producing truck on a small scale and retailing it in the near-by towns. There is room here for only a few farms in this kind of business, but some of these, so long as they are able to find a market for the produce, are finding the business profitable. Irish potatoes were profitable, as shown by the cost of production, which was 52 cents per bushel, and the value, which was $1.01 per bushel. These are planted in July, well toward the end of the cotton-plowing season, and the cultivating is done during August and September, when there is not much other farm work to do. The rainfall in these months is also ample for growing potatoes. They may be left in the ground and harvested at any time during the winter. Late Irish potatoes handled in this way are a comparatively new crop and are grown on only a few farms, but because they are profitable and do not interfere with other crops it appears that 1 or 2 acres per mule would add to the profits of many farmers.

Alfalfa is also a new crop in this area, the possibilities of which are not yet fully known. Since the survey was made, alfalfa has been planted on 10 or more farms, and the fields appear promising. If the results are as good as have been obtained at Rock Hill, S. C., on a soil very similar in type, it should prove a valuable addition to the farms and greatly facilitate the growing of live stock needed for home consumption. An acre per mule carefully planted and handled should prove profitable. The velvet bean, which farmers are just beginning to plant, is also a promising crop in this section. Early varieties mature before frost, and, when planted with corn, the yield of corn is reduced little, if any, and a good yield of beans is obtained. The fodder on the corn can not be "pulled" where velvet beans are planted, but the soil improvement and the feed from the beans will ordinarily more than compensate for any loss incurred in this way.

Soy beans offer possibilities for this area. A few farmers already have planted soy beans for feed, but the limited market for the beans has prevented the extension of the acreage. Soy beans are now crushed for oil and meal by cotton-oil mills, so that there is a ready market for the seed. This should encourage farmers to grow the crop. Soy beans can be planted in rows in the spring immediately after cotton planting is finished. They are cultivated very much like corn and harvested for seed late in October or early in November. There are machines which straddle the row and pick and thrash the beans in the field. Soy beans can also be planted for hay after oats and wheat, and harvested in the same manner as cowpea hay. It is also probable that they can be planted after oats and harvested for the seed. Inoculation is necessary for best results.

CROP ROTATION.

The preceding pages show quite definitely the limitations of the various crops grown in this area. The most suitable crop rotation for the well-organized farm can therefore be determined quite accurately. Other crops may be added to this rotation and variations made to suit the individual farm. But if one of the rotations outlined below is followed, the necessary steps are taken to secure good yields, and the proper acreage of crops are grown per mule, the farm should prove profitable.

TABLE XXIII.—*Three methods of planning a five-year rotation for this area.*

Year.	1	2	3
First year	Cotton	Cotton	Cotton.
Second year	Cotton	Cotton	Corn with cowpeas.
Third year	Cotton	Corn with cowpeas	Cotton.
Fourth year	Corn with cowpeas	Cotton	Cotton.
Fifth year	Oats followed by cowpeas.	Oats followed by cowpeas.	Oats followed by cowpeas.

The average acreage and the most profitable acreage per work animal has been shown to be between 20 and 23 acres. Taking this as a basis, 40 per cent, or two-fifths, of the crop land will, under average conditions, grow the feed crops required for home consumption, leaving 60 per cent, or three-fifths, for cotton. This makes a five-year rotation, which may be cotton, cotton, cotton, corn with cowpeas, and oats followed by cowpeas, as shown in Table XXIII. In many instances it would also be advisable to plant oats after cotton and cotton after corn, as the oats can be drilled in the cotton rows, and less labor in planting would be required. The objection to planting cotton after corn is that the corn stalks interfere with the cotton cultivation. With 20 crop acres per mule in staple crops there would be five fields of 4 acres each, or, with 22½ acres, five fields of 4½ acres each.

In addition, there should be some miscellaneous crops which may or may not be made a part of the rotation. With 20 acres of staple crops per mule there would be 12 acres of cotton and 4 acres each of the other crops, or if there were 22½ acres, there would be 13½ acres of cotton and 4½ acres each of the other crops. With this as a basis, it would be an easy matter for the farmer to substitute 1 acre of oats and vetch for 1 acre of corn, and perhaps another acre of oats, followed by Irish potatoes, for a second acre of corn, if the individual case warranted it. This would require the feeding of a higher proportion of oats and hay to live stock than is now fed, but as the cost of producing these crops is relatively less than the cost of producing corn, the change would be profitable to the farmer. Alfalfa can be added to this cropping system as it is found profitable, and winter cover crops can be planted in cotton to increase yields.

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LOGAN WALLER PAGE, Director

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THE WET LANDS OF SOUTHERN LOUISIANA AND THEIR DRAINAGE.

By CHARLES W. OKEY, *Senior Drainage Engineer.*

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INTRODUCTION.

Louisiana ranks second among the States in the area of swamp land within its borders and in the percentage of its total area that is classed as swamp land. Of a total area of 45,420 square miles, 15,930 square miles, or 35 per cent, are classed as swamp and overflowed land. The drainage of these lands is a public improvement of very great importance to the future wealth and prosperity of the State. Although the magnitude of the task has long been recognized and the tremendous advantage that the reclamation of these lands would bring to the State has been generally admitted, it is but recently that the work of putting the swamp land into condition for cultivation has been attempted on any large scale. A number of conditions are responsible for this delay in the work, among which the following are important:

First, a very large proportion of the swamp lands of the State at one time was subject to overflow by the Mississippi River. The first step in the drainage of these lands was to protect them from river overflow by levees constructed along the main river channels. This phase of the work has been going on in some parts of the State for more than 100 years, and in nearly

all parts of the overflowed section since about 1875. It has been carried forward as fast as funds could be secured for the work. Second, the former abundance of cheap and well-drained agricultural land in this and other parts of the country made these lands unattractive. Third, the necessary State laws were not enacted until recently.

As the above-mentioned obstacles have been removed in a measure, the work of swamp-land drainage is attracting serious and widespread attention. The most active field of drainage operations at present is in the southern portion of the State, and it is there that the Department of Agriculture has been carrying on drainage investigations for about eleven years. The purpose of this work has been: (1) To study the soil, climate, and other natural conditions with special reference to the drainage problems encountered and the value of the land for agricultural purposes when successfully drained. (2) To collect such technical data and to examine such details of present practice as will afford information of value to landowners, and especially to engineers interested in the reclamation of such lands. (3) To disseminate the results of the investigations and to encourage land drainage by emphasizing the benefits to be derived from bringing such lands under cultivation.

Reports of results obtained have been made at frequent intervals, and partial reports have been published as often as seemed advisable. It is the purpose in this bulletin to include all salient features of the information so far published and to give also the results of later investigations. Where direct quotations from earlier publications are made, credit is given, but much of the material contained in the earlier publications and reports is so interwoven with later and more complete information that no specific mention is made of its source. The scope of this bulletin is as follows:

First, a description of general conditions in this section of the State, of such a nature and in such detail that persons unfamiliar with this or similar sections of the country will be able to form a fairly accurate idea of the nature of the problems encountered in the successful drainage and clutivation of these swamp lands.

Second, the results of detailed examinations of four drainage districts, reclaimed or in process of reclamation, and a summary of such results.

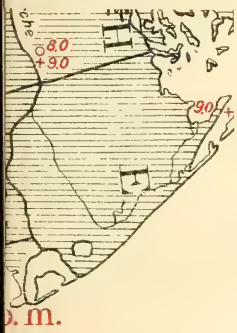
Third, a consideration of the problems involved in land drainage by means of pumps in Louisiana. This discussion might be considered as a continuation of another bulletin published by this office dealing with pumping in the upper Mississippi River Valley.[1]

LOCATION AND GENERAL CONDITIONS.

As shown by figure 1, the area under consideration lies on the immediate Gulf coast. A range of hills running eastward from Baton Rouge, the State capital, to Lake Pontchartrain, forms, with the lake, the northern boundary of the portion lying east of the Mississippi River. Most of the land in this area is from 1 to 3 feet above sea level, with a very small percentage lying along the river and the larger bayous having an elevation of from 4 to 15 feet. To the westward, between the Mississippi and the Atchafalaya, the land rises gradually from sea level along the Gulf to an elevation of perhaps 15 or 20 feet along a line drawn from Baton Rouge to Lafayette, except in the immediate vicinity of the Atchafalaya River, where it is very little above sea

[1] U. S. Dept. Agr., Office Public Roads and Rural Engineering, Bulletin 304.

NOTE.—This revision of Department Bulletin 71 contains information of value to landowners, engineers, and others interested in drainage by pumping, especially of the wet prairies along the Gulf coast.



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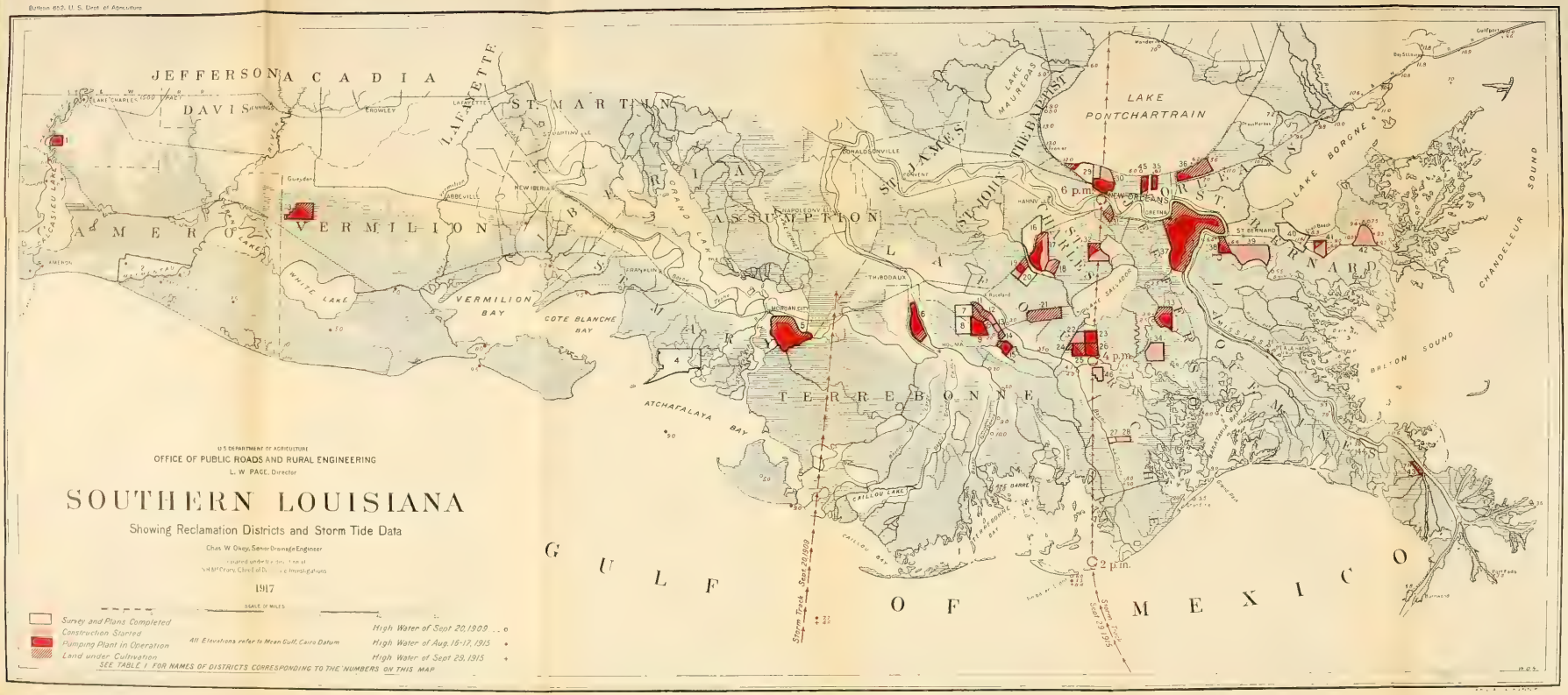

Fig. 1. Map of Southern Louisiana Showing Reclamation Districts and Storm Tide Data

level. In this section, as in the area to the east of the Mississippi River, there is a small percentage of higher land along the rivers and bayous. To the westward of the Atchafalaya River there is a strip of swamp land bordering the coast line which rises gradually from sea level to approximately 10 or 15 feet above at a distance of 20 or 30 miles inland.

The area of the district is about 12,000 square miles, of which about 10 per cent is high enough to be drained by gravity, this representing the percentage of the total area that already is drained and under cultivation. The remainder is so low that artificial means must be used to get an outlet for drainage water. The area shown in figure 1 is about one-fourth that of the entire State, yet the tract contains nearly two-thirds of the State's swamp land.

Throughout the entire district are connecting lakes and bayous, many of which are navigable by boats of considerable draft. The total length of such navigable streams is, roughly, 1,600 miles. The main waterway is the Mississippi River. The Atchafalaya River lately has been opened to deep-water navigation through a dredged channel at its mouth, and vessels of a draft of not more than 20 feet can enter it safely. This system of waterways insures excellent water transportation to the entire district, in addition to the facilities afforded by a number of railroads which traverse the district.

Besides the cities of New Orleans and Baton Rouge, there are several towns in the district, including Morgan City, Houma, Donaldsonville, New Iberia, Lafayette, Crowley, and Lake Charles, the principal railroad center of the western part of the State.

The very small percentage of this area that is under cultivation is worked very intensively and supports a population exceeding 200 to the square mile over the whole area. While the principal industry of the whole region is agriculture, the wealth derived from other sources, including sea food, lumber, oil, gas, salt, and sulphur, is almost as great.

CLIMATE.

Temperature.

In Bulletin W of the United States Weather Bureau the following statement is made:

Climatic conditions over southern Louisiana are marine in character; the proximity of the Gulf of Mexico and the numerous streams and lakes of this region all conspire to modify the temperature conditions and prevent sudden changes therein, and extremely warm weather in summer and severe cold weather in winter seldom occur.

For further information in regard to temperature see above-mentioned publication.

Rainfall.

The Weather Bureau summary of the climatological data for section 45 says of the yearly rainfall:

There is a gradual and well-defined decrease in precipitation from the eastern toward the western portion of this section. The average annual precipitation is 55.76 inches, and ranges from 48.36 inches at Lakeside, Cameron Parish, to 63.02 inches at Amite, Tangipahoa Parish. The precipitation is practically all in the form of rain and is well distributed throughout the year. Snow occurs on an average of once in three to five years, and disappears soon after having fallen. Although droughts occur, they are seldom long continued,

Note.—Acknowledgment is made of the helpful spirit of cooperation displayed by railroads, companies installing drainage systems, landowners, and practicing engineers in extending the scope and increasing the accuracy of this work.

and are not so serious as in regions where the level of the ground water is so much farther below the surface of the earth. June and July are usually the wettest, and October and November the driest months. Rain falls about once in three days. The average number of rainy days is 108 in the eastern and from 77 to 80 in the western portion of this section.

The following rainfall data are taken from the Weather Bureau records:

Mean monthly and annual rainfall, in inches, at Cameron, New Orleans, and Houma, La.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Cameron	3.71	3.29	3.23	3.23	3.70	5.76	7.70	3.98	5.32	2.94	3.91	3.36	50.13
New Orleans	4.63	4.57	5.30	4.91	3.88	6.16	6.47	5.61	4.81	2.93	3.79	4.46	57.52
Houma	3.45	4.77	3.45	4.12	3.58	5.91	9.23	6.35	5.92	3.04	2.68	4.31	56.81

The rainfall in this section is more or less tropical in character, especially in the summer months. The rains nearly always are purely local in the summer, and the amount, both daily and monthly, may vary greatly for stations separated by only a few miles. Thus we have a monthly total in August, 1911, of 28.5 inches at Donaldsonville, at the northern edge of this section, and but 12.27 inches at Houma, only about 40 miles away. The following table, compiled from the daily rainfall records of the United States Weather Bureau at New Orleans, from 1871 to 1916, gives the average number of storms per year of given intensities:

Average yearly number of storms of given intensities.

(Based on daily rainfall records of the U. S. Weather Bureau for New Orleans, La., 1871 to 1916, inclusive.)

Total rainfall.	Average number of storms per year.														
	1-day period.	2-day period.	3-day period.	4-day period.	5-day period.	6-day period.	7-day period.	8-day period.	9-day period.	10-day period.	11-day period.	12-day period.	13-day period.	14-day period.	15-day period.
3 inches	1.652	2.998	3.972	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4 inches	.673	1.372	1.828	2.172	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5 inches	.326	.674	.847	1.021	1.130	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6 inches	.196	.369	.456	.630	.762	0.848	.....	.....	.....	.....	.....	.....	.....	.....	.....
7 inches	.153	.217	.304	.345	.391	.479	0.587	.....	.....	.....	.....	.....	.....	.....	.....
8 inches	.109	.153	.153	.217	.283	.283	.326	0.270	.....	.....	.....	.....	.....	.....	.....
9 inches	.022	.065	.087	.109	.153	.196	.196	.240	0.304	.....	.....	.....	.....	.....	.....
10 inches	.....	.....	.043	.065	.109	.153	.196	.196	.240	0.261	.....	.....	.....	.....	.....
11 inches	.....	.....	.022	.043	.065	.065	.087	.130	.130	.174	0.196	.....	.....	.....	.....
12 inches	.....	.....	.....	.....	.043	.065	.087	.087	.087	.087	.087	0.109	.....	.....	.....
13 inches	.....	.....	.....	.....	.....	.022	.043	.043	.043	.043	.043	.043	0.087	.....	.....
14 inches	.....	.....	.....	.....	.....	.022	.022	.022	.022	.022	.022	.022	.065	0.065	.....
15 inches	.....	.....	.....	.....	.....	.022	.022	.022	.022	.022	.022	.022	.043	.043	0.043

HEALTH CONDITIONS.

Of the healthfulness of this climate the Bureau of Soils says:[1]

A most serious check to the attraction of a desirable class of immigrants to this section is the impression which has gotten abroad as to its unhealthfulness. That this idea had some foundation in the past can not be denied, but such a condemnation can not now be applied to the State as a whole or to this particular vicinity. The records of the medical board of New Orleans show that the city has an excellent health record for a city of its size. * * *

[1] U. S. Dept. Agr., Field Operations of the Bureau of Soils, 1903, pp. 443, 444.

Outside of the city sanitary conditions are naturally much better. The dwellings of both owners and the tenants of the plantations stand on the higher land along the Mississippi River, where there is adequate natural drainage. Notwithstanding the proximity of the swamps and standing water, malaria, though occasionally occurring, is not dreaded. Until within the last few years epidemics of yellow fever caused frequent alarm, but this disease has now been thoroughly eradicated, and with the methods of treating the disease and preventing its spread it is not to be dreaded as formerly, even if it should again appear.

Since it has been demonstrated that malaria, like yellow fever, can be transmitted to man only through the bite of a certain species of mosquito, it may be expected that drainage, which destroys the breeding places of these pests, will result in a decrease in whatever malaria now may exist. As a matter of fact, malarial fever is very rare on the immediate coast line, and the health of people who come from other sections seems to be fully as good as that of those born there.

SOILS.

The area under discussion contains soils that are peculiar to the section, and these now are being drained and cultivated for the first time. In the following section are set forth the results of first-hand investigations, along with the classification and general descriptive matter taken from publications of the United States Bureau of Soils.

Area East of the Atchafalaya River.

ORIGIN AND FORMATION OF SOILS.

The soil of the area east of the Atchafalaya River and in parts of St. Mary, Iberia, and St. Martin Parishes is of alluvial origin and is largely the result of deposits made by the Mississippi River and its branches. It has been built up from a depth of several thousand feet to the present elevation above the Gulf. In the very newest portions of the Delta at Port Eads, at the mouth of the river, a considerable subsidence of the land still is going on, the measured rate being about 0.11 foot per year. That this subsidence is due to a compacting of the newer deposits is shown by the fact that permanent bench marks along the Mississippi River record a decreasing settlement as the distance from the mouth of the river increases. Except in this relatively small area near the mouth of the river, the remainder of this section of the State shows no change in elevation. As is typical of delta regions, ridges of sandy soil are found along the main river channel and along its branching outlets. The manner in which these ridges were formed is well brought out in the following from "A Preliminary Report upon the Bluff and Mississippi Alluvial Lands of Louisiana," by W. W. Clendenin.[1]

[1] Louisiana Stas. Rpt. Geology and Agriculture, Pt. IV, p. 263.

With every flood the river now overflows its flood plain and deposits much of the sediment from its headwaters. As with a slight increase in velocity the transporting power is vastly increased, so with a slight checking of velocity, as occurs over the flood plain outside of channel, deposit takes place. As the greatest decrease in velocity takes place near the channel, there the heaviest and coarsest sediment is deposited, and in greatest quantity. The river banks are thus built higher by each flood and a system of natural levees is produced. There is thus a marked difference in the "front lands" and the "back lands" along the river. The former are higher and coarser textured than the latter, and therefore much more easily cultivated and drained.

Drainage from the very channel margin is away from the river, and unless forced by the topography of the land, will not reach the river proper, but unite with some outlet of the river produced during some extraordinary flood

period and kept open by the escape of water during ordinary periodic flood stages. As the feeders of the river are called tributaries, these outlets have not inaptly been styled distributaries.

Since practically all land in the Delta region now is protected from overflow by levees along the Mississippi River, all building up of the low marshlands has been checked. However, at the mouth of the Mississippi River deposition of material is continually taking place.

Even before the construction of the artificial levee system, there was no raising of the general level of the marshes during periods of normal flow and probably little sedimentation of the river bed excepting at its mouth, the most of the material which was carried in suspension to the lower portion of the river being carried out and deposited in the Gulf. As the river rose, however, the waters constantly sought additional outlets through the various bayous of the Delta country. At times of extreme high water there was a general breaking over the banks of the river and its outlets. It is probable that the most of the building up of the lands above sea level has been done at such times.[1]

The above statements show that while the Mississippi River and its various distributaries are extending themselves continually through deposition at their mouths, it was only at times of overflow that the ridges along the channels were raised or widened. The peculiar branched nature of the Delta, with bodies of land extending fingerlike into the Gulf, with open spaces of water between, is also thus accounted for. As these ridges gradually widened they approached each other, thus forming lakes and bayous. Tidal action usually kept these ridges from inclosing the open water between them, and heavy and prevailing winds no doubt often would change their character and direction. It is reasonably certain that the large inland lakes, such as Lake Des Allemands and Lake Salvador, were inclosed in this manner.

The fact that the silt-bearing capacity of water is directly dependent upon the velocity is clearly demonstrated by observing the natural embankments formed by streams of various sizes. In the case of smaller streams, when the water overflows its force is soon spent and the silt is quickly deposited near the stream, forming narrow ridges with steep side slopes, while those formed by large streams are broad with slight slopes. Three typical examples showing this difference and the manner in which the land surface has been raised on the marshes are given in figure 2, A, B, and C.

The sections were taken as follows:

A—From the right bank of the Mississippi River across the Willswood plantation, about 10 miles above New Orleans. This section is about 2 miles long, and a part of the lands crossed have been under cultivation for a great many years, while those farthest from the river were reclaimed only 12 or 15 years ago. The lowering of the surface of the cultivated and drained fields due to the shrinkage of humus soils is here well illustrated. There are many examples of highlands having been built up for much greater distances from the river than this, but as such accretions are indirect, on account of being formed by a number of small bayous or temporarily contracted areas of overflow which assisted in maintaining the velocity, these have not been considered as being typical.

B—The right bank of Bayou Lafourche at Lockport, extending back through the village of Lockport and beyond to Lake Fields. Until 1903 Bayou Lafourche served as an overflow outlet for the Mississippi River, the opening at Donaldsonville not having been permanently closed until that year.

C—This is a very small bayou extending to about 4 miles west of Lockport. The abrupt rise of the ridge from the surrounding marshes is especially noticeable and is characteristic of smaller bayous.

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[1] Manuscript report of A. M. Shaw.

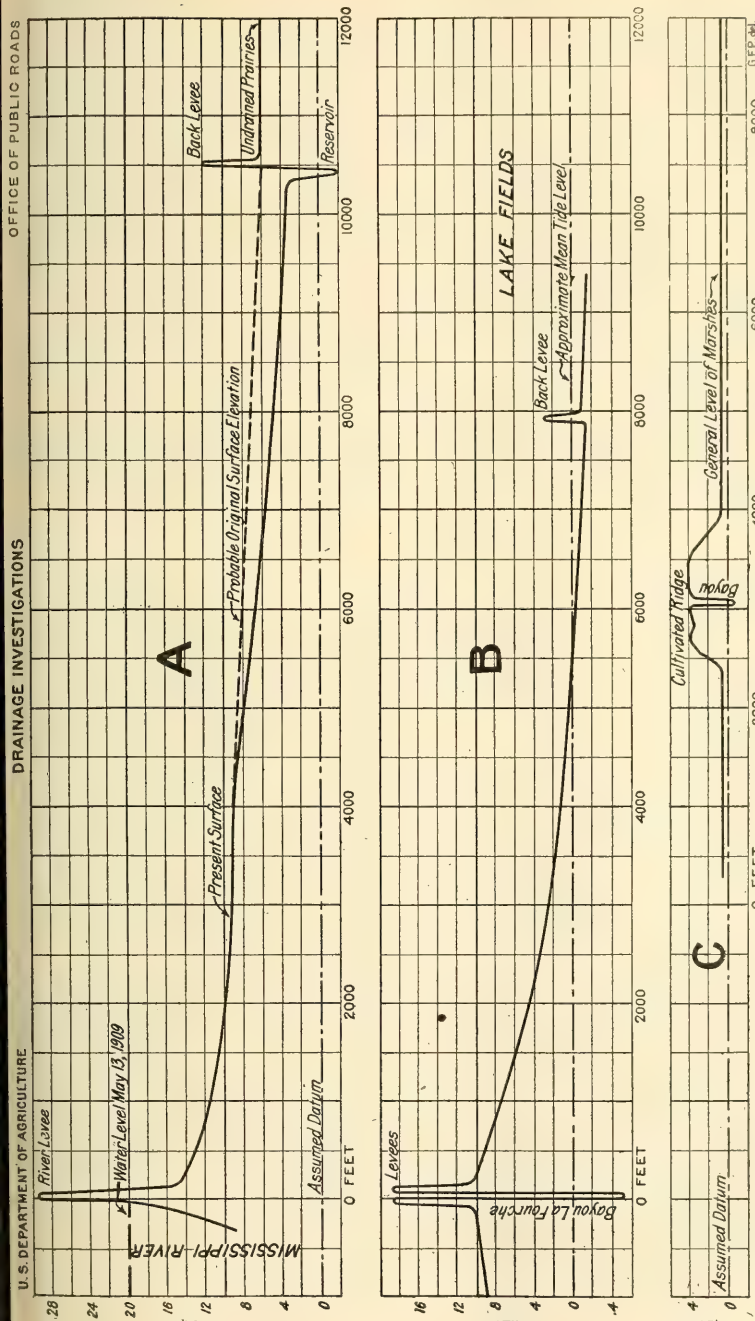

FIG. 2.—Typical examples of Louisiana marshland formation: A, Profile through Willswood Plantation; B, section through Smithport Plantation; C, formation caused by small bayou near Lockport.

Important exceptions to the foregoing general statement as to the relation between the size of bayous and the ridges built by them are frequently found. Prominent among those are the Bayou L'Ourse, in the southeastern part of Lafourche Parish, and the Wax and Little Wax Bayous, in St. Mary Parish. Bayou L'Ourse is an insignificant stream, occupying the center of a long and important ridge. It is probable that at one time this bayou served as an outlet for Lafourche, or possibly for some predecessor of the latter bayou for draining in a more easterly direction through Bayou Blue, Lake Fields, and Long Lake. Wax and Little Wax Bayous are streams of erosion rather than of sedimentation and have been formed wholly or in part by the action of storms and the tidal flow, which is quite strong along this portion of the coast. As a result, the bayous are bordered by the marsh or by very low ridges. Both streams are from 10 to 50 feet in depth and 100 to 200 feet in width.[1]

In addition to the above, Bayous Terrebonne and Black, in Terrebonne Parish, are typical examples of the sedimentation type; while Bayou des Allemands, the connection between Lake Des Allemands and Lake Salvador, is an excellent illustration of the tidal-erosion type.

From the foregoing it may be seen that the chief difference between the various types of soils is the variation in fineness of material rather than difference in chemical composition.

CLASSIFICATION AND EXTENT OF SOILS.

The various types of soils grade imperceptibly into each other, but the following classifications have been made by the Bureau of Soils: Yazoo sandy loam, Yazoo loam, Yazoo clay, Sharkey clay, muck, and Galveston clay. The first three are ridge soils and limited in extent; they form a very small percentage of the total area. These soils have sufficient elevation to drain by gravity, and as practically all are well drained and cultivated they will not be discussed further. The last three classes include practically all the undrained soils of this section. The Sharkey clay is a heavy alluvial soil. For the top 5 or 6 inches it is black, due to the heavy percentage of decayed vegetable matter; the subsoil is a brown or drab, waxy, very impervious clay. The soil shrinks greatly on drying, leaving large sun cracks. This, combined with the effect of the decayed vegetable matter, causes the soil to break up very readily under the plow. For the most part the Sharkey clay areas are heavily forested, the better-drained portions having a dense growth of hardwoods and the wettest portions being covered with cypress.

The muck and Galveston clay areas are practically the same. On top of the above-described Sharkey clay the decaying vegetation of the open grass-covered prairies has formed a mass of material which is quite variable in character. Where it is almost pure vegetable matter it is classed as muck or peaty muck, and where the percentage of silt or clay is rather heavy it is classed as Galveston clay. The depth of this layer of vegetable matter varies from a few inches to several feet. In its natural state it nearly always is covered with water and is very soft and boggy. For a further description of these soils see the publications of the Bureau of Soils.[2]

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[1] Manuscript report of A. M. Shaw.

[2] U. S. Dept. Agr., Field Operations of the Bureau of Soils, 1903, p. 451–453; also 1911.

Area West of the Atchafalaya River.

ORIGIN AND FORMATION OF SOILS.

Most of the land of this section consists of recent coastal plain deposits rather than of Mississippi River alluvium, and surface conditions are somewhat different from those encountered in the eastern or delta section of the State. Instead of a succession of ridges and shallow lakes, such as occur in the delta section, we have a costal plain rising gradually from south to north. Along the immediate coast line there is a more or less unbroken sandy ridge through which the rivers have cut channels. Immediately back of the ridges are stretches of salt marsh very little above sea level, but which rise gradually to the north, so that at a distance of some 5 to 10 miles inland they become fresh-water marsh. The larger streams, such as the Mermentau, the Calcasieu, and the Sabine, still deposit alluvium, and since the coast line was elevated these streams have extended considerably the land adjoining them. As the waters of these outlets are very sluggish and are not heavily loaded with silt, they have not built up large ridges along the immediate river banks. The alluvial portion is nearly level, and the strips of alluvial land along the channels widen gradually as the streams approach the Gulf. These alluvial strips still are in process of formation and of elevation by deposition, since at each high water the adjoining lands are flooded, the rivers not having been leveed.

CLASSIFICATION AND EXTENT OF SOILS.

The Bureau of Soils has not made surveys of this section, but has examined and classified the soils immediately north of it. The various clays, clay loams, silt loams, and sandy loams are described in detail in publications of that bureau.[1] Toward the Gulf the above-enumerated soils are overlain by muck and alluvial deposits and thus become subsoils.

The lands of this section might be divided into two main divisions, as indicated in the paragraph on origin and formation: (1) The general wet prairie land, with a comparatively shallow deposit of silt and muck on the surface; and (2) the strips of alluvial land along the river channels or streams. The first class includes the great bulk of the lands. As noted above, the subsoils of this portion are the solid loams, etc., of the higher land, thus affording a firm foundation quite different from the soft, yielding alluvial silt of the Mississippi Delta swamps. Overlying this subsoil occurs a shallow deposit of partly alluvial silt caused by local erosion and weathering. There is little or no muck on the surface of the higher and better-drained portions, although the silt of the top 6 inches is rich in vegetable matter due to the decay of the grasses. These portions are covered with water only during the rainy season, and in times of long drought ordinary wagons can be driven over them. Toward the south, however, the land is water covered practically all of the time, and a layer of muck has formed from decaying prairie grass. In its essential characteristics this muck is very similar to that of the Mississippi Delta section. It averages from 6 to 18 inches in thickness, although in low depressions and shallow bayous it may be several feet deep. Owing to the absence of any extensively silt-bearing streams, the muck of these wide level prairie sections is composed almost entirely of vegetable matter, and its dry weight is less than that of the average muck of the Delta section. This, however, should not be an undesirable feature, as most of it is so shallow that the cultivation soon will extend into the

[1] U. S. Dept. Agr., Field Operations of the Bureau of Soils, 1901 and 1903.

silt below. As the coast line is approached, as noted before, the marsh becomes salt, but it is covered with practically the same depth of muck. In various places in this section there are broad zones where the silt deposit between the muck and the underlying subsoil is perhaps 3 or 4 feet deep and has a chocolate-brown color similar to that of the soil of the Sharkey clay regions. These areas are more numerous in the lower portions of the prairie.

Along the larger rivers, especially near their mouths, the alluvial belts of soil are quite wide. In these sections the rivers have laid down alluvium many feet in thickness on the older deposits. The building up of these flood plains has been very slow, and the marsh-grass growth has been continuous; thus we have near the top a muck with a high percentage of silt, grading down into a silt with a large percentage of vegetable material at a depth of from 1 to 4 feet. Parts of this alluvial section are soft, although the land immediately along the river channels sometimes is quite firm. The muck is similar to that of the Mississippi Delta section, except that the silt is well mixed with it instead of occurring in alternate layers.

DRAINAGE CHARACTERISTICS OF SOILS.

As the ultimate success of most of the reclamation districts of this section depends on the successful drainage and cultivation of the muck lands, a rather detailed study of them was made. In investigating these soils it was the endeavor to get a careful description of their physical characteristics, to find the percentage of water by volume that they would contain when in good condition for growing crops, and to ascertain the amount of water they would hold when completely saturated.

The muck is a mass of vegetation in varying stages of decay and contains varying amounts of river silt. It differs in character according to the kind of vegetation from which it was derived; thus the muck of the cypress swamp is much darker and less fibrous than the muck or turf of the open, grass-covered prairie. Also, according to stage of decay, it may be tough and fibrous and able to bear the weight of a man, or it may be soft and even semifluid if considerable water be present. Being the result of growth rather than of deposit, it has been formed in layers, the depth of which depends largely on the time involved. When a layer of vegetation is covered with a heavy layer of silt all addition to the former ceases, and if conditions be favorable a new layer of vegetation is formed on the silt above. Thus we have strata of muck varying in thickness from an inch to several feet, with intermediate strata of silt of depths of from 1 inch to perhaps 2 feet. About half of the waterways that extend through these swamps are streams of tidal erosion; along these streams the high ridges of river silt are absent, and the muck is specially deep. Bayou des Allemands, Wax Bayou, and Little Wax Bayou are streams of this character.

The samples of muck examined were taken at just sufficient depth below the surface to insure the optimum percentage of water—i. e., the amount of moisture considered by local plantation owners to be the best for the growth of general field crops. No samples were taken immediately after a rain or after a long dry period. At the time of taking the samples a description of each field was made, including depth of water table, length of time the field had been drained and cultivated, time since last rainfall, character of original vegetation, nature of present crop, and other conditions peculiar to the tract in question. The following tables show the results of tests made in the spring of 1910:

Results of soil tests on Lafourche drainage district No. 12, subdistrict No. 2, Raceland, La.

No. of sample.	Depth of sample.	Number of days since rain.	Weight per cubic foot.			Water in soil by volume.			Depth of water table.
			Normal.	Saturated.	Dry.	Normal.	Saturated.	Gain.	
Turf:	*Inches.*		*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*	*Inches.*
12	4–10	7	45.8	61.5	7.0	62.1	87.2	25.1	18
13	4–10	7	54.4	.....	8.7	73.1	.....	.....	18
22	4–10	10	44.0	.....	9.4	55.4	.....	.....	20
23	4–10	10	45.8	62.3	12.4	53.4	79.8	26.4	20
24	5–10	10	43.9	.....	10.7	53.1	.....	.....	20
25	5–10	10	46.7	60.7	14.0	52.3	74.7	22.4	20
30	3–8	14	41.3	61.5	7.6	53.0	86.2	32.3	20
31	3–8	14	41.3	.....	7.9	53.4	.....	.....	20
32	6–10	14	51.2	.....	7.9	69.4	.....	.....	22
33	6–10	14	47.3	57.6	7.3	64.0	80.5	16.5	22
Turf with silt:									
10	8–12	7	57.9	71.3	21.2	58.7	80.5	21.4	20
11	8–12	7	61.4	.....	22.8	61.8	.....	.....	20
14	12–16	7	64.0	77.6	29.5	55.2	77.0	21.8	18
15	12–16	7	66.0	.....	30.0	57.5	.....	.....	18
16[1]	3–7	7	53.7	67.9	14.9	62.0	84.8	22.8	20
17[1]	3–7	7	56.2	.....	16.9	62.9	.....	.....	20
26[1]	3–8	10	54.8	.....	16.9	60.6	.....	.....	24
27[1]	3–8	10	46.7	64.9	8.7	60.8	89.9	29.1	24

[1] Turf and silt after being mixed by two years of cultivation.

The above samples were taken from the soil on subdistrict No. 2, which lies about 5 miles from Bayou Lafourche and the same distance from Raceland. This district is a part of the open, grass-covered prairie and had been well drained for about three years. Its elevation is perhaps a foot above mean tide level, and the soil probably would be classed as Galveston clay. The fields from which these samples were taken were in cultivation in 1909 and were planted to corn or sugar cane in the spring of 1910. The original vegetation was a wild prairie grass, locally called "paille fina." The muck or turf was formed from this grass. The soil of the top 4 to 5 inches was quite soft and dry, having been recently cultivated. Just below the depth of cultivation the soil became moist, and water would drip from it when compressed. The muck here was of a dark-brown color and very light and spongy; after drying it became much darker in color. It seemed to be a mass of partially decayed grass and grass roots and had very little, if any, silt in its composition. The depth of the muck on this tract varied from 6 to 18 inches. Below this came a layer of mixed turf and silt about 1 foot in thickness, and from there on down to a great depth occurred pure silt which would be classed as Sharkey clay. The ground-water level stood a little less than 2 feet below the surface, which is about the average depth of drainage secured on this tract. The first 10 samples in the table were taken from the layer of pure turf; the next four, Nos. 10, 11, 14, and 15, from the layer of mixed silt and vegetation just under the layer of pure turf; and the last four, Nos. 16, 17, 26, and 27, from a field on the same tract that had been cultivated for two years, but that had not been cultivated in 1910 when the samples were taken. The last four samples show the result of deep plowing, thus mixing the silt and the pure turf, and give an idea of the conditions that may be expected after the fields have been cultivated for a time.

The following table gives the results of tests of the muck on Lafourche Drainage District No. 12, subdistrict No. 3, which lies a little farther out from Bayou Lafourche than does subdistrict No. 2.

Results of soil tests on Lafourche drainage district No. 12, subdistrict No. 3, Raceland, La.

No. of sample.	Depth of sample.	Number of days since rain.	Weight per cubic foot.			Water in soil by volume.			Depth of water table.
			Normal.	Saturated.	Dry.	Normal.	Saturated.	Gain.	
Muck:	*Inches.*		*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*	*Inches.*
28	4–9	10	48.9	.....	10.0	62.2	.....	.....	18
29	4–9	10	51.2	63.7	10.8	64.7	84.7	20.0	18
34[1]	3–8	14	59.2	.....	10.0	78.7	.....	.....	12
35[1]	3–8	14	58.2	63.8	10.2	76.8	85.8	9.0	12

[1] Samples 34 and 35 were undoubtedly too moist for optimum percentage of moisture.

The conditions on this area were similar to those on subdistrict No. 2, except that the land on the former had been well drained only eight months and had not been cultivated. The top of the muck was covered to a depth of about 4 inches with a tough sod full of heavy grass roots, but below this soil these roots tapered out to very fine rootlets. The samples contained pure turf which was very similar to samples 12 to 33, inclusive, of subdistrict No. 2.

The samples recorded in the following table were taken from Smithport Plantation, which lies about 1 mile back from Bayou Lafourche, near Lockport, La.

Results of soil tests on Smithport Plantation, Lockport, La.

No. of sample.	Depth of sample.	Number of days since rain.	Weight per cubic foot.			Water in soil by volume.			Depth of water table.
			Normal.	Saturated.	Dry.	Normal.	Saturated.	Gain.	
Muck:	*Inches.*		*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*	*Inches.*
18	10–15	4	54.4	.....	21.9	52.0	.....	.....	22
20	8–13	4	52.0	.....	13.4	61.8	.....	.....	22
40	7–12	14	52.9	73.0	14.0	62.2	94.4	32.2	26
42	8–13	14	52.0	61.5	10.7	66.1	81.3	15.2	22
Silt:									
19	3– 7	4	112.0	.....	88.6	37.5	.....	.....	24
21	2– 7	4	80.0	.....	48.3	50.7	.....	.....	24
41	2– 7	14	74.8	85.6	47.0	44.5	61.8	17.3	26
43	3– 7	14	111.5	.....	81.9	47.4	.....	.....	26

This tract was a part of the grass-covered prairie which contained a number of scattering groves of small willows. It had been cleared and drained for about five years. Its elevation above mean tide level is about 1 foot. The top soil is a layer of almost pure silt 6 to 10 inches thick which has been laid down on a layer of muck perhaps 12 inches thick at a comparatively recent date. Below this muck is a deposit of pure silt extending to a great depth. The turf or muck in this tract is perhaps older than that of subdistrict No. 2, Raceland; it seems to have been formed from the same kind of vegetation, but it is heavier and much darker than that of the latter district. This is due probably to the weight of the layer of silt which had been deposited on it. The ground had been cultivated in 1910, and the part moved by cultivation was quite hard and dry; however, this cultivation did not reach below the layer of silt, into the muck. The first four samples were taken from the layer of muck, while the next four were taken from the silt overlying the muck. Both layers of soil were tested so as to get an idea of

the combined water capacity of the two varieties, for many of the plantations have a mixed soil much like that of the Smithport Plantation.

The samples recorded in the following table were taken in Bayou Lafourche sandy loam near Lockport and about one-fourth mile back from the bayou.

Results of soil tests near Lockport, La.

Number of sample.	Depth of sample.	Number of days since rain.	Weight per cubic foot.		Water in soil by volume.	Depth of water table.
			As taken.	Dry.		
Sandy loam:	*Inches.*		*Pounds.*	*Pounds.*	*Per cent.*	*Inches.*
36	3-8	14	105.9	81.2	39.5	40
37	3-8	14	105.4	80.6	39.7	40
38	6-11	14	105.9	75.4	48.8	40
39	6-11	14	105.4	78.1	43.7	40

The soil in this tract is representative of the average soil conditions in the bayou-front plantations. It also is of much the same nature as the ridges of silt that occur in many of the turf or muck lands. The soil had been cultivated for a great many years, and little vegetable matter was present. It already had been cultivated in 1910 when the samples were taken. The ground was quite moist to the touch, but was perhaps a little drier than usual. The soil was much the same to a very great depth. The tests were made for the purpose of comparison with the tests of the muck.

It will be noted by comparing samples 40 and 42, in the summary of results of soil tests on the Smithport plantation, with samples 36 to 39, inclusive, taken near Lockport, that the muck soil seems to be more retentive of moisture than the sandy loam of the bayou ridge. The samples of each class of soil were taken at approximately the same depth and on the same date, yet the muck contained nearly 50 per cent more water than the sandy loam. Later in this same season, which was unusually dry, the crops on the muck soil withstood the effects of the drought better than did those on the sandy ridge soil.

In general, the layers of turf or muck of southern Louisiana having been formed on an alluvial deposit, and in many cases mixed with silt, the turf after a few years of cultivation works up into a most excellent soil which is well balanced in chemical composition. This is proved by the excellent yields of both truck and general field crops on such lands near Lockport and Raceland. The muck of the cultivated fields has a greater density and a darker color than that where the land is undrained and uncultivated. In its original state the pure turf is a light brown, but as it dries and decays it becomes darker and finally is almost black. When first drained it is very light and spongy and when plowed breaks up into rather large pieces, sometimes as much as a foot square, which are pushed ahead of the plow instead of being turned in a furrow. After the second year of cultivation, the muck loses its fibrous nature and resembles old sawdust in texture, although a little darker in color. As cultivation continues the muck mixes more and more with the underlying silt, and a much heavier and more impervious soil results.

SUBSIDENCE OF SOILS.

It is well known that swamp lands having soils containing a large percentage of vegetable matter subside when drained and cultivated. This subsidence is due to three main causes—drying, decay, and cultivation. Shrinkage and the consequent subsidence, due to drying, affects mostly the top layer but ex-

tends in a decreasing degree as deep as the soil is drained. Tests have shown that undrained Louisiana muck shrinks about 60 per cent in volume when completely dry, and that it will regain only 70 per cent of its original volume when saturated for a long time. Therefore long-continued dry weather and deep drainage cause a shrinkage in the deeper layers of muck which is not fully offset by any increase in volume which occurs after subsequent precipitation or rising of the water table. Only such part of the muck as is always saturated is entirely free from shrinkage due to drying.

The vegetable material in muck soils exists in a state of partial decay. In the undrained state it is so saturated with water that the process of decay is relatively slow. After drainage the air enters, and decay is much more rapid. The warm, humid climate of southern Louisiana is very favorable to the rapid decay of vegetable material, much more so than are those sections where the surface is frozen for a part of the year. Like the effect of drying, that of decay is greatest in the top layer of material, but examination has shown that after some years of drainage the character of the muck at a depth of 2 feet is materially changed. While the effect of decay is not as rapid in action as that of drying, it is practically continuous. The complete decay of the vegetable matter causes some loss of weight and considerable loss in volume, thus gradually reducing the surface elevation of the muck.

As the effects of both the foregoing agencies are greatest in the top layer of the muck, the density of this layer is gradually increased. After this comparatively dense material attains a thickness of a few inches it prevents free circulation of the air into the muck below, and then drying and decay are much slower in their action. Eventually this layer attains such a thickness that further subsidence of the surface is scarcely noticeable.

Cultivation increases the subsidence directly by the mechanical effect of weight compacting the soil, and indirectly by accelerating the action of drying and decay. Muck soils that are so soft after drainage that they will not permit of the use of farm animals and machinery, are compacted from 4 to 6 inches by the first plowing. This first plowing is usually done with some form of tractor with broad wheels that cover practically all the surface plowed. Subsequently, when the muck is cultivated with farm animals and machinery, the surface receives unit pressures far greater than exerted by the broad-wheeled tractor, and a further compacting results. The underlying material turned to the surface by plowing is exposed to a greater drying action than otherwise would result. Decay, also, is hastened in the material thus brought to the surface. It is the experience in cultivating newly reclaimed muck soils that for a number of years after the first cultivation a uniform depth of plowing will bring to the surface each year a considerable layer of muck which was undisturbed by the previous year's plowing. This layer of new material decreases in thickness from year to year, until finally the cultivated layer attains such density that the combined forces of drying, decay, and compacting reduce its thickness very little. If the land is not plowed deeper than this layer the subsidence of the remaining muck is very slow; but if the land is plowed deep enough to reach undisturbed muck, further subsidence results.

LIABILITY OF BURNING.

In the reclamation of turf lands of this character there always is more or less danger that the muck will burn. On some of the newer plantations trouble has been experienced in burning off the growths of weeds and grass that covered the muck. This burning off can be done with safety only when the muck is wet from a recent rain. In the spring of 1910, which was the driest in southern

Louisiana since Government weather records have been kept in the State, the muck began to burn on subdistrict No. 3, near Raceland. This tract had been drained but about eight months. A rain of three-fourths of an inch failed to extinguish the fire. It became necessary to dig a ditch around the fire deep enough to reach to the silt below. This method of checking fire is practicable and efficient if it is adopted soon enough.

The danger that any considerable area of the reclaimed land will burn is very remote. The system adopted in reclaiming this land—that of dividing it up into comparatively small levee districts—would limit the extent of the fire, and the division of the districts themselves into small areas by the lateral ditches makes it impossible for the whole of any plantation to be in great danger from fire. The danger from extensive burning to the muck of unreclaimed swamp land is not great, even when the muck is very dry, for the ridges of river silt which occur at frequent intervals would serve as effectual checks to any great progress of the fire. Even if the muck be burned from a tract of land, the underlying silt makes a very excellent although a somewhat heavy and impervious soil.

The best preventative against the muck burning is cultivation. This prevents the growth of grass or weeds that might burn when dead or extremely dry. All such growth should be plowed under rather than burned, provided it is not so heavy as to make good plowing impossible. If it becomes necessary to burn the growth the burning should not be done when the muck is even partially dry. After several years of cultivation the muck will become much heavier and firmer and be much less likely to burn. However, in extremely dry times precaution should be taken to avoid burning any thing in the fields.

CROPS.

The staple crops grown in this section of the State are sugar cane, rice, corn, forage crops, and truck. In certain parts, especially along the lower portion of the Mississippi and in other districts near the Gulf, large areas are planted in oranges and other citrus fruits. In the eastern, or Delta, portion sugar cane is the most profitable general field crop, while in the western portion rice is grown almost as exclusively as is sugar cane in the eastern. Some corn is grown in both sections, but not enough to supply the local demand. Of the adaptability of the type of soil called the Sharkey clay, the Bureau of Soils says:[1]

The Sharkey clay was not especially adapted to cane and cotton and was no temptation to producers of these commodities, but the increased interest of late years in the production of rice has given a new value to this soil, and if the problem of drainage can be cheaply and successfully solved, the soil is admirably adapted to the production of this crop. Near New Orleans the reclaimed areas are devoted to the dairy business and to market gardening. The fertility of Sharkey clay is almost inexhaustible, and when well drained it is adapted to any crop which requires a fertile clay soil. The crops most profitably grown near New Orleans are onions, cabbage, eggplant, and tomatoes.

The soil is exceptionally easy to cultivate, due to the large percentage of vegetable matter present. In times of drought it retains moisture much better than the other soils in this section, and good crops have been produced on it when there were almost complete failures on adjacent sandy lands, owing to the lack of moisture.

While practically the entire list of staple and truck crops suitable to this climate have been grown profitably on the reclaimed areas, sugar cane, corn, and oats have been the principal crops. Yields of all crops have been good

[1] U. S. Dept. Agr., Field Operations of the Bureau of Soils, 1903, p. 452.

and compare favorably with the yields secured in the best sections of the Mississippi River Valley. The long growing season allows the planting of a winter crop of oats, which is harvested early in the spring so as to allow the planting of corn on the same lands so that it has ample time and favorable conditions for maturing in the autumn. The long and favorable growing season makes possible many combinations of crops. With some combinations the same area of land produces three crops in a year. The mild winters make stock raising profitable, as green feed can be grown during the entire year.

NATURAL DRAINAGE CONDITIONS.

The natural surface drainage of this section is away from the Mississippi River and larger bayous of sedimentation, directly into the Gulf by way of bayous of the tidal erosion type. However, numerous canals are being cut through the bayous of the first type from the low-lying swamp or prairie lands, thus aiding in the drainage. Water covers the surface of the undrained lands for the greater part of the year. This water comes from three different sources—direct precipitation, river overflow, and tidal overflow.

Overflow Due to Direct Precipitation.

The water to be removed from these lands comes mostly from direct precipitation, and it is with reference to the removal of this water that the nature and capacity of natural drainage channels will be discussed.

Owing to the slight elevation of the land above sea level, all of the streams are very sluggish in character. Their surface slopes always are very slight and are due entirely to the piling up of the water in the interior until sufficient head is created to force the water out to the Gulf. At times of high tide in the Gulf and small precipitation in the interior, the current often is reversed in many of the streams, and salt water then flows many miles inland. However, at such times the water in the channels is so low that the tide rarely causes a stage sufficient to flood any of the adjoining land. (This condition should not be confused with tidal overflow, which will be discussed later.) The fluctuation in water level, due to direct precipitation, in the various bayous and interior lakes is never very great and depends quite as much upon the drection of the prevailing winds as on the amount of precipitation.

Bayou Lafourche is one of the largest and longest natural drainage channels in this section, extending about 120 miles into the interior. A gauge has been maintained for more than seven years at a point about 70 miles inland from the Gulf, and back about 1 mile from the bayou on a canal which connects with the general water level in the swamps. The extreme variation of the water surface observed at this gauge was 4.5 feet. The lowest stage was caused by a prolonged and record-breaking drought in the spring of 1910, at which time salt water had reached the gauge. This reading, which is approximately sea level, was 1.3 feet below the average stage of water at this point. The highest stage was reached in October, 1916, after a rainfall of about 21 inches in 15 days, when the water stood 3.2 feet above average water level.

At points farther inland the fluctuation in water level is proportionately greater. The situation on Bayou Lafourche is mentioned because it is typical of all the long, sluggish bayous that carry away the drainage water. Most of the interior watercourses are connected with each other by cross bayous and canals, so that they are all somewhat similar in their action. The drainage areas are very poorly defined and no doubt lap somewhat, as some of the connecting canals and bayous often reverse direction of current according to the stages of water in the various parts of the system; for this reason it is prac-

tically impossible to measure the run-off from these drainage areas. It is probable that the natural run-off is very low, owing to small slopes and the rank vegetation on all the land, only about 10 per cent along the bayous being under cultivation. The bayous of sedimentation are quite free from growth of vegetation, many having a considerable boat traffic, which tends to keep them cleared out and in good condition as drainage channels. Those of tidal erosion are apt to be overgrown with water hyacinths, but owing to their greater depth these are also quite efficient channels.

As shown in figure 1, many parts of this section discharge their drainage water almost directly into the Gulf or into large interior lakes that undergo very little fluctuation in water surface. Thus these areas are relieved of all drainage water due to direct precipitation without great rise of water in the carrying channels. In the interior portions, such as that contiguous to the upper part of Bayou Lafourche, there often are rises of water level of several feet in the main drainage channels. In this flat country a rise or 3 to 4 feet in the main drainage outlet is a very serious matter and one that demands attention.

In reclaiming land in this section the usual practice is to inclose the district with levees to keep out the surrounding water; the drainage water of the land so inclosed is then pumped over the levee into some natural bayou that leads to the Gulf. If the fluctuation in water level in this outlet bayou is great, not only is a more expensive pumping plant equipment necessary, but the cost of the levees is very greatly increased. As the usual height of the levees is but from 3 to 5 feet above the ground level of the marsh, a rise of 3 to 4 feet in the outlet bayou will often endanger the levees, or at least cause a considerable seepage through them. The danger from seepage is especially great, because the fluctuation of the water level takes place very slowly. Several times in the past seven years the water has stood 1.5 feet above mean tide level for more than a month, and at one time it stood for more than a month 2 feet above mean tide. As a result, levees that were satisfactory in ordinary times allowed much seepage to enter the district they protected, and heavy and continued pumping was necessary.

Up to the present time little attention has been given to the problem of the disposal of the drainage water after it is pumped over the levees. Some sections never will be compelled to give this matter consideration, owing to their favorable locations on or near the Gulf or some other large body of water. On the other hand, there are sections of wet prairie that are isolated from any large bodies of water by distances of from 20 to 75 miles along the shortest natural outlet channel. In the first years of reclamation no difficulty was experienced in getting outlets, for the surrounding limitless prairie was so little above sea level that the drainage water spread out immediately, causing no trouble; but in some localities so much land now has been reclaimed that the effect on the carrying capacity of the natural watercourses is becoming noticeable. As the work of reclamation goes forward and district after district is reclaimed until a considerable portion of the whole area is appropriated, the drainage water, when pumped over the levees, can not spread over the surrounding prairie, for the latter will be inclosed by the levees of adjoining districts. The water then will be forced to flow through long winding channels to the Gulf, the distance often being as great as 75 miles. This will mean that the water level on the outside of these interior districts must rise until sufficient head is created to cause a movement of the water to the Gulf, thus greatly increasing the cost of reclamation and rendering unsatisfactory much of the work that is now apparently finished.

In the planning of gravity drainage districts the common interests of adjacent districts in securing good outlet facilities have long been recognized in all parts of the country. Experience has shown cooperation between such districts to be necessary. As yet most of the reclamation districts that secure drainage by pumping are independent of each other, and, as pointed out above, those which are fortunately situated will remain so. On the other hand, interior sections will eventually need better outlet facilities to the Gulf if the present policy of developing small independent districts is continued.

It is evident that the various districts should be so correlated that there will be no interference between the different interests. This makes necessary a general survey of this district, covering the topographic and hydrographic features. A survey of this scope would show the probable future necessity of increasing the present capacity of the natural drainage channels, or perhaps of providing additional outlet channels for some of the more isolated sections. It is quite likely that such additional channels could be used as commercial canals, thus making them doubly valuable. The section of the country lying between Bayous Lafourche and Terrebonne, in the parishes of the same names, is an excellent illustration of an area that eventually will need better outlet facilities, parts of this area now discharging drainage water through 80 miles of natural drainage channel to reach the Gulf. As shown by the gage at Lockport, the natural water surface in the swamps already has a large fluctuation, and any further extensive reclamation will considerably increase this fluctuation.

The drainage of nearly all the land in the above-mentioned section is now effected, and the owners of land now drained by gravity should cooperate with those owning pumping districts to improve the main drainage channels or construct new ones. The responsibility for improving and maintaining these main channels rests equally on all land in this area, although the assessments for the work would be made according to benefits. It would be far better to take proper action in time to prevent loss due to poor drainage, rather than to delay action until crop yields are decreased and land values depreciated.

River Overflow.

Like all delta regions, this one originally was subject to peroidic overflow. The smaller floods of the Mississippi River were confined within the natural levees that the stream itself has built up, but at irregular intervals of some years great floods would cover practically all of the delta for months. As soon as any serious attempt was made to bring this land under cultivation, levees were built along the Mississippi River banks to protect the lands from overflow. Finally districts were organized which included long stretches of river, and millions of dollars have been spent in levee improvements. This expenditure, with such Federal aid as has been available, has built a continuous levee system on both banks of the river throughout its length in the district under consideration. The levees have been increased in size as fast as the protected land could supply the money. In the earlier years, owing to insufficient cross section of levees and low grade line, crevasses were of frequent occurrence in times of high water. As more and more work was done on the levees a greater degree of protection was secured, and now crevasses are rare, although the levees are not yet up to the full height planned. However, the amount of cultivated land protected by these levees is increasing very rapidly, thus not only enhancing the security for bond issues necessary to finish the levees, but also increasing the revenue-producing power of the land to pay the annual tax to retire such bonds. The agricultural developments of southern Louisiana, which

are all dependent on this levee system, are among the oldest and most uniformly successful in the country. Engineers who have made a detailed study of the levee system are certain that with its completion this entire area will be protected from overflow of the Mississippi River.

The above remarks apply only to the alluvial section of the State, as very little land west of the Atchafalaya River is affected by Mississippi overflow. Some of the larger streams, such as the Calcasieu and the Sabine, flood the alluvial flats immediately along their banks to a depth of perhaps 4 or 5 feet, but as a whole the wet prairie lands of the western portion of the coast are free from river overflow.

Tidal Overflow.

The daily range of tide along this portion of the Gulf coast is small, the average being from 0.5 to 1.5 feet. However, as is true of all low, flat coasts bordering on wide areas of comparatively shallow water, heavy winds blowing for any considerable time directly on-shore may cause a rise of several feet in the water. Such rises commonly are called storm tides. Their effect is so great that often they reverse the ordinary tide, and the maximum height of water may be reached at the usual time of low tide. Storms of this character usually are confined to the months of August, September, and October, and are known as tropical hurricanes. Those severe enough to cause large rises in the tide occur at comparatively long and irregular intervals. Sometimes they will affect only a comparatively small portion of the coast line, while at other times a general rise of several feet will be recorded all along the coast line, with a limited region where the storm center strikes the coast experiencing a tide of perhaps twice the height of the general rise.

Within the period covered by the investigations three characteristic storms caused abnormal tides along the Louisiana coast. These occurred, respectively, on September 20, 1909; August 16–17, 1915; and September 29, 1915.[1] High-water records for these storms were collected and are shown on figure 1, the heights of water caused by the different storms being given in distinctive symbols. Where only one height is given, it is much greater than that for either of the other storms. While the centers of these storms did not follow the same path, the effects of all three were felt in varying degree on the entire coast. It is difficult to draw any general conclusions in regard to tides caused by tropical hurricanes. However, it is believed that it will be of value to summarize the facts that were observed in the very detailed examinations that were made.[2]

The highest tides and the greatest damage seem always to be east of the track of the storm center, and the effect of the disturbance usually extends farther to the east than to the west, although differences in character and shape of coast line sometimes will make the opposite true. Regions fairly close to the track, whether to the east or west, will suffer. The height of the tide depends on the intensity, duration, and direction of the wind and on the shape and exposure of the coast line. The offshore depth of water also will have some influence and the nature and amount of vegetation on the land will have a great effect on the heights at points not immediately on the shore line. Funnel-shaped bays facing directly toward the hardest wind are likely to have the highest tides, as shown by the records at the upper end

[1] For detailed descriptions of these storms see U. S. Dept. Agr., Monthly Weather Review for the months in which the storms occurred.

[2] For a full report of the investigations on storm tides along the central Gulf Coast, see special report of C. W. Okey, of September, 1916.

of Timballier and Terrebonne Bays and at the southwest end of Lake Pontchartrain. Low, barren strips of land like that near Port Eads, and islands like Timballier, which allow the water to pass on across without much obstruction, are not likely to experience as high tides as land which is higher or covered with trees, or as that portion of the mainland which is covered with a heavy coat of tall grass.

The rising water flows inland with considerable velocity and piles up on any obstruction, such as a railway embankment or a strip of heavy timber. Such an obstruction will delay the progress of the water until it rises sufficiently to pass over or around the obstacle. Usually sufficient time is not allowed for the water to assume anything near a level stage over any considerable area, and great differences of level are to be expected within a short distance, especially near the limit of overflow or where the water is obstructed. This is shown by the heights observed south of Houma, on Bayou Terrebonne, and between Michaud and Lee Station, on the Louisville & Nashville Railway. Quite often there occurs a shifting or even a reversal in direction of the wind as the water reaches its highest stage. This will cause great local differences in stage. Points a long distance from bodies of open water do not experience overflow from tides, as the water does not have sufficient time to travel inland before a change in the wind occurs, and heavy strips of timber retard the flow to a remarkable degree.

No method of forecasting the maximum height of water to be expected at a given point seems possible. However, as the highest stages recorded in the last three storms are the highest yet experienced in those comparatively limited areas, it is not likely that they will be exceeded soon. In the areas removed from the centers of these storms higher tides may be caused by storms striking the coast at other points, and future storms undoubtedly will cause tides which show a different variation, as between the various localities, from those already experienced. It is suggested that in estimating the height of tide to be expected at a given point an area in the region of maximum recorded tides which is similar in all features to the one in question be selected for comparison. As future storms may exceed those of the past in both intensity and duration, a margin should be allowed for safety.

From an examination of the heights reached by storm tides, as shown in figure 1, it would appear that reclamation districts on many portions of the coast will be compelled to build levees not only to keep out the waters of the surrounding swamps, but also to prevent tidal overflow in times of storm. The heights of tide indicated on this map are the highest experienced since the country has been settled, and they should govern the heights of levees in the various localities. Areas well inland from large bodies of water connecting directly with the Gulf need not expect to feel the effect of storm tides.

In connection with the general problem of protection from tidal overflow, the plan of providing a protection levee for the whole coast line, rather than that of constructing individual levees for each district, has been considered by local engineers. The feasibility and cost of such a plan could be determined only after a complete survey of the district had been made and a comprehensive plan had been carefully worked out. However, some general features can be stated to give an idea of the nature of the problem. The larger the levee district, other things being equal, the less the cost per acre for levee; for the length of the levee per unit of area, for districts which are roughly square, varies as one divided by the square root of the area. Moreover, doing work along broad lines and handling earthwork in large quantities will reduce the unit costs of construction. In fixing the outlines of such large areas advantage can be taken of many natural features of the land to be protected, which

will reduce further the cost of levee and drainage-channel construction. This will consist principally in utilizing the natural ridges as levees and the natural streams as drainage channels.

While it is not considered feasible to include the entire section under discussion in one or two levee districts, it would appear that the number of such districts could be made comparatively few; and if an attempt is to be made to reclaim any considerable areas near the coast line, or where the storm tides are likely to be above 6 feet, the question of a general protection levee for that section of the coast should receive careful consideration. Where the storm tides are likely to exceed 6 feet the cost of the levee will become such a heavy proportion of the cost of reclamation that often it will be proper to construct the general protection levees in advance of the construction of the other drainage improvements, that is, to give protection from tidal overflow to more land than is to be drained completely and utilized immediately.

DESCRIPTION OF RECLAMATION DISTRICTS.

Previous to about 1907 there had been no active movement in the drainage of the wet prairies lands of Louisiana. The older plantations along the Mississippi River and other large alluvial streams had extended their clearings back to the belt of cypress swamp that usually lies between the ridge along the streams and the grass-covered prairie; there, owing to the expense of clearing such land, further progress usually was checked. At some points, however, where this belt of timber was narrow, the plantations were extended to include relatively small areas of prairie land. Such areas were inclosed with levees, ditches were cut, and pumping plants installed. The land thus reclaimed on such a small scale has proved to be fertile and has been farmed with entire success.

About eleven years ago the present movement for reclaiming large areas of wet land began, and districts consisting entirely of wet prairie land were inclosed by levees, and drainage systems installed. The degree of success attending these early reclamations interested people from many points outside as well as within the State, and at present the amount of capital invested in drainage improvements is very great. From the drainage engineer's standpoint the work passed the experimental stage long ago, and by following the best methods used on existing districts the successful drainage of the average type of wet prairie land is assured. Many problems which in the earlier stages of the work confronted those in charge have been solved successfully by study and experiment. It is the primary purpose of this bulletin to set forth the results of investigations made so that one new to the work may readily become familiar with the best practice as carried on in the present state of development.

The degree of success attained in the various methods used in the reclamation of these lands has been investigated closely by this office. The investigation has included studies of the natural features of a number of drainage districts and of the levees, reservoir canals, field laterals, pumping plants, and methods of cultivation, as well as of the records of rainfall and run-off. A large number of districts have been examined closely, and practically every district within the State has been inspected.

To explain better the nature of the drainage problems encountered and the reclamation methods employed, a detailed discussion of some typical reclaimed areas will be given, and a summary of the results of all investigations presented. These examinations were made during the period from 1909 to the latter part of 1916, and descriptions refer to conditions obtaining during that time and at the end of the period.

EXPLANATION OF TERMS.

Before proceeding with the discussion of the reclamation districts a brief explanation of some of the technical terms hereinafter used will be given.

By run-off is meant the water that flows over or through the ground to drainage outlets. All run-off originates in precipitation; therefore the latter is the most important of all the factors that influence the rate of run-off, some other controlling features being size, shape, topography, and geological structure of the watershed, climatic conditions, and the character of the vegetation.

In so-called gravity drainage districts the run-off is removed by gravity through the main outlets. In pumping districts the run-off is collected at some point within the district and pumped over or through the levee. The rate of run-off is expressed as a quantity of water removed in a unit of time. This quantity of water can be conceived as a certain depth distributed uniformly over the entire drainage area. Similarly, the capacity of a pumping plant is the quantity of water, expressed in a depth distributed uniformly over the drainage area, that the pump can dispose of in a given time. As used in the following discussion, the rate of run-off is expressed by the depth of water, in inches, distributed uniformly over the drainage area, that passes from the area in a period of 24 hours. Likewise, pumping-plant capacity is expressed in terms of a depth of water, distributed uniformly over the drainage area, that can be removed by the plant in 24 hours of continuous operation. Reservoir capacity, also, is represented by a uniform depth distributed over the drainage area. The object of expressing the rate of run-off and the pump and reservoir capacities in depths rather than in volumes per unit of time is to arrive at a basis of comparison that is independent of the drainage areas. On any particular tract, the area being known, these rates can easily be reduced to cubic feet per second or to any other convenient unit.

In a long period the total amount pumped would equal approximately the run-off for that period; but for short intervals, as, say, 24 hours, the run-off from an area might be much greater than the quantity pumped, the excess being stored in the reservoir for subsequent pumping.

WILLSWOOD PLANTATION, WAGGAMAN, JEFFERSON PARISH, LA.

This plantation is selected for discussion because it is typical of the character of pumping district that was drained first in Louisiana. Conditions prevailing in this plantation are also typical of those on all river and bayou front lands, and as most of the land at present in cultivation in this section of the State is of this character, a rather detailed description of conditions will be given.

As shown in figure 3, this plantation, of 2,600 acres, fronts on the Mississippi River and extends back into the prairie swamp lands in the rear. About one-third of the area of the present plantation originally was prairie land and was included by an extension of the levees in 1896. A pumping plant was installed, and cultivation has been continuous since that date. The area of prairie land included was typical of such land in this part of the State and was covered with a scattering growth of willows and the usual rank growth of grass. Originally the muck was about 4 feet deep and was overlain by a layer of river silt about 4 to 6 inches thick, although at present, after 22 years of cultivation and decay, it is well compacted and has subsided or shrunk until it now averages from 2 to 3 feet lower than it was originally. The total fall in the surface of the ground from the front to the rear of the plantation is about 10 feet.

LEVEES.

As the front portion of this tract drains toward the land in the rear by gravity, it is inclosed only partially by levees. Starting where the ground is about 5 feet above mean Gulf level, levees were built around the lower portion to a height of nearly 7 feet above mean Gulf level. The levees were built by a dipper dredge with material taken from the inside of the district. The canal resulting from the levee building was used for a reservoir. The ground was quite soft, and the levees were built up in several layers, and owing to the

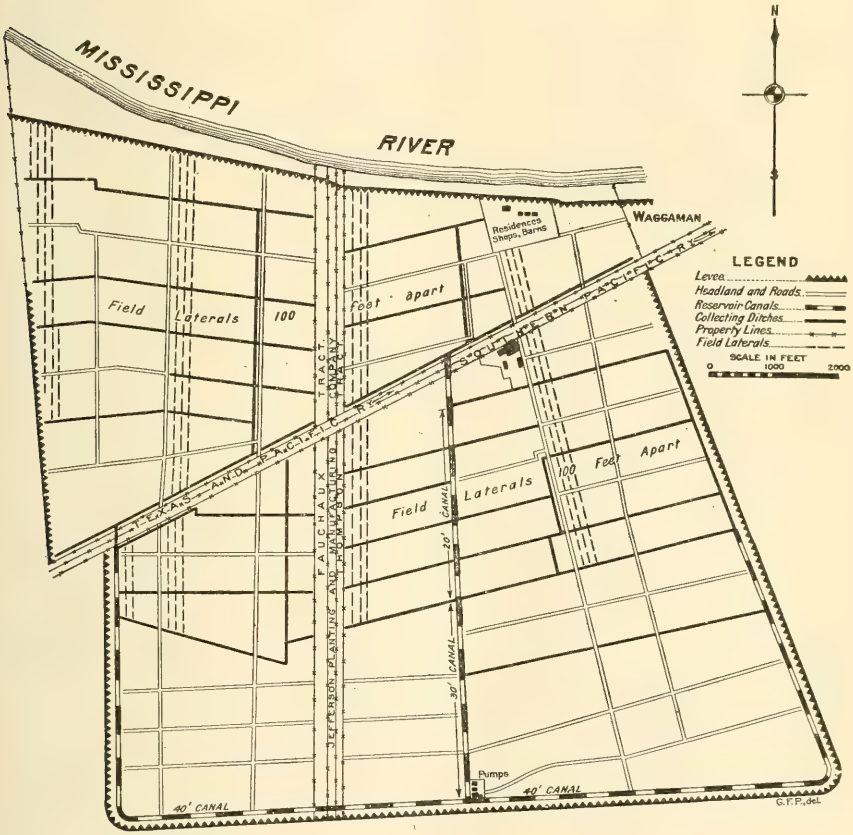


FIG. 3.—Sketch map of Willswood Plantation, Waggaman, Jefferson Paris, La., showing ditch and levee system.

soft nature of the ground the excavated material formed a good bond with the foundation. The berm left between the levees and canal was from 10 feet to 15 feet. In 1912 these levees were increased in height to about 9 feet above mean Gulf level by the use of a 1-yard orange-peel dredge mounted on a barge floating in the reservoir canal. The levees now have a top width of about 5 feet and side slopes of 2 to 1. As they stand to-day the levees seem to be almost impervious to seepage water. Nothing could be learned as to seepage water during the first year after construction, but the levees show no evidence of any sliding material due to seepage. The water usually is about a foot deep over the land on the outside of the district, though it sometimes

becomes somewhat deeper during heavy and continued rains. There often are periods of a month or two when the surface is dry.

Experience in other districts has been such that the locating of the reservoir canal immediately on the inside of the levee, using the material excavated from the canal in building the levee, might be expected to give trouble in causing a great deal of seepage through the levee into the canal. However, because of the great width and height of this levee the seepage is not noticeable. The subsoil under this levee is rather better than usual.

RESERVOIR CANALS.

By using these canals as a reservoir it was necessary to construct only a comparatively short canal into the interior of the district to give outlet to the collecting ditches. These are mostly about 5 feet deep, with 10-foot top widths and 3-foot bottoms, and serve as outlets for the small laeral ditches.

Until the levee was increased in height in 1912, the canals had not been cleared of silt since their construction, about 1896. They had needed clearing and deepening very badly for several years, as the water could not get to the pumping plant very rapidly after the level was reduced to about 2 feet below the land surface. Moreover, there was very little reservoir capacity available, and the canals had to be kept almost dry to afford a proper depth of drainage. After the material was taken out of the canals to increase the size of the levee they were of ample size. The pumping plant now can be operated at nearly full capacity until the water in the canal is reduced to a very low level, and the water comes from the farthest portion of the canal quite rapidly. Therefore it is not necessary to start the pumps so soon to take out the small amount of water that collects from ground-water drainage.

A considerable portion of the front of this plantation is high enough to drain by gravity. A diversion canal should be run across the front of the property so as to carry the water toward the eastern side of the plantation and thence into a canal which leads to land about 1 or 2 feet above Gulf level. This diversion canal or ditch should be connected with the outside of the district by means of a self-acting sluice gate which would insure against water coming in from the outside. The ditch would keep the water from the high land from pouring rapidly back toward the lower land near the pumping plant as it does at present. At times of very heavy rainfall a considerable area in the vicinity of the pumping plant is flooded for periods of from a few hours to more than a day. After most of the water from the higher land had been diverted outside, the district gates could be opened in the lower side of the diversion canal so that the low-water flow could go back toward the pumping plant and allow the canal to be drained completely. This improvement would save many floodings of the lowest portion of the plantation and also a considerable amount of fuel for pumping-plant operation. It is a feature which should be investigated very carefully when making a study of the best plan for draining lands of this character.

DITCHES.

The ditches on this plantation are of about the usual cross section on such lands, having depths of 3 feet, top widths of 3 feet, and bottom widths of 1½ feet. The spacing of the ditches varies with the character of the land. Thus, on the front lands, which are rather impervious, the spacing is about 100 feet, while on the newer lands taken in from the prairie the spacing is from 200 to 500 feet. On the front lands the laterals between collecting ditches are about 2,000 feet long; small, considering the large slope of the land. Conditions on similar plantations where the ditches are twice as long indicate that the laterals

on this district could be made of the same length. On the back lands, however, the ditches already are about as long as would be advisable, since the land is almost level. At present these ditches are too shallow to give adequate drainage. Some measurements of the depth of water table were made early in the summer of 1910. The results are shown graphically in figure 4. It is apparent that at that time this soil was not very impervious. Even after heavy rains the profile of the ground water was not steep. The ditches are too far apart for the best results, although if they were the full 3 feet deep they would drain the ground much better. Now that the reservoir canal is of a good depth these ditches could be cut as deep as 4 feet and still be pumped dry. If instead of cutting new ditches between the present ones lines of tile were placed midway, the purpose would be served even better and considerable land would be saved. The present ditches evidently are sufficient to take away the surface water, and, because of the open nature of the subsoil, the ground water would be taken away readily. The cost of maintenance alone on these extra ditches would nearly pay the interest on the cost of the tile work above that of the new ditches; in addition, there would be the saving in land. Furthermore, if tile were laid properly they would give the same amount of drainage all the time, whereas ditches give their best results only for the first few weeks after they are cleared of grass and weeds.

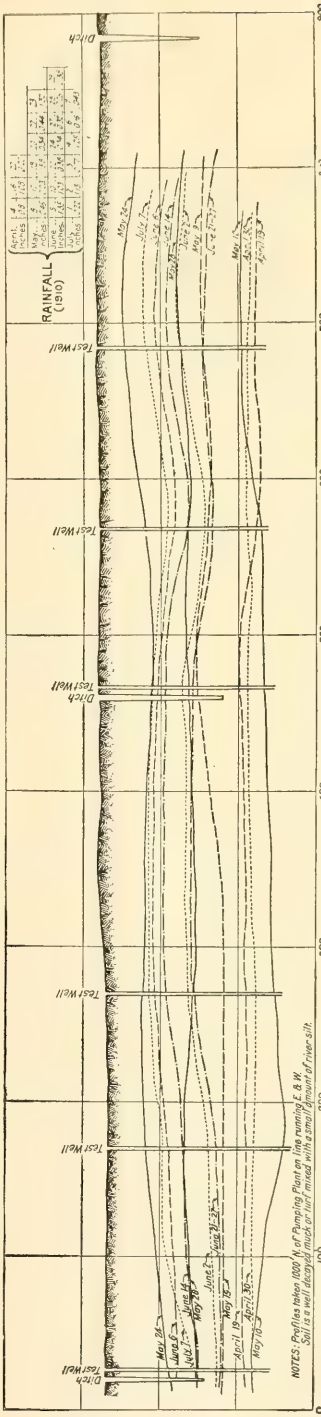


FIG. 4.—Profiles of ground water, Willswood Plantation.

PUMPING PLANT.

The location of this plant is quite favorable, as it is on the lowest ground in the tract and at the junction of three large canals, making the distance the water must travel to reach the plant about as short as is practicable.

Steam for the three following pumping units is furnished by two water-tube boilers and one return tubular boiler, crude oil for fuel and a feed-water heater being used.

First, a rotary chamber-wheel pump, having a capacity of 40,000 gallons per minute, rope driven from a 16 by 24 inch automatic, noncondensing engine; second, one 42 by 16 inch Menge pump, connected by a rope drive and a bevel gear to a 16 by 24 inch automatic noncondensing engine; third, one

centrifugal pump with 36-inch diameter discharge pipe, direct-connected to a double, vertical engine. Pumps 1 and 2 discharge into open flumes at an average head on pump of about 10 feet, which is about 5 feet greater than necessary. Pump 3 has a siphon on the discharge pipe, but the end is not always submerged.[1]

The capacity of this plant usually has been large enough to remove the water before any damage has resulted from flooding. Due to the use of rope drives, the plant has been stopped several times for repairs when the loss of a pump was a serious matter.

As a whole the plant is very inefficient, but is quite typical of the pumping plant usually found on the old river-front plantation. Owing to the excessive lift, the cost of pumping is considerably higher than it should be. In another portion of the bulletin will be seen figures covering the detailed cost of operation for this and other plants. The main defects of this plant are a long and poorly designed set of piping on the 36-inch centrifugal pump, open sluice discharges on the other two pumps, causing an unnecessary lift of about 5 feet, and rope drives on two of the pumps.

Condition of Land for Cultivation.

For two years after the tract of prairie land in the rear of this plantation was reclaimed it was cultivated with only such drainage as was afforded by the reservoir canals. Then the present lateral ditches were cut, and good drainage was secured for a number of years. Not much detailed information was available concerning conditions in this early period. It is known, however, that during this time excellent crops were grown on the prairie land and that these crops were uniformly better than those grown on the older front lands. Until the last seven or eight years the prairie lands were so much better drained than the front lands that plowing could be done on the former when the water stood on the surface of the front lands. As is shown by figure 4, the depth of drainage was not much over a foot in 1910. This condition has been bettered somewhat by the deeper canal. However, crops were reported as being good, even with such shallow drainage. The fact that the crops did not seem to stand drought well undoubtedly was due to the very shallow depth of root growth that such a small depth of drainage would permit. As this tract is a part of the typical wet prairie land found in this section, the results obtained show that the successful reclamation of these lands is a certainty.

NEW ORLEANS LAKESHORE LAND CO. TRACT, NEW ORLEANS.

This tract lies along the southern shore of Lake Pontchartrain, about 4 miles east of the northern limits of New Orleans. As shown in figure 5, the frontage on the lake is about 7 miles. The width at the eastern end is about 2 miles and at the western 1½ miles. Most of the surface originally was covered with a heavy growth of grass, with only a small percentage of the area timbered. The elevation of the surface was a few inches above mean lake level, and except for a few small ridges and shell mounds the tract at one time was subject to overflow whenever the lake was at high tide. A considerable depth of turfy humus or muck covered the entire area; the range in depth was from 1 foot along the lake shore to as much as 10 feet in the portion 1 mile back from the lake. The average depth of muck was perhaps 5 feet.

[1] U. S. Dept. Agr., An. Rpt. Office Expt. Stas., 1909, p. 420.

Reclamation work was first started in 1908, and a small pumping plant was erected at the eastern end of the tract. Construction of the interior canals and the building of the levee followed. While the levee was carried entirely around the district to a moderate height, the canals were not all cut for several years. After the early part of 1913 construction work was carried on more rapidly and was practically completed in the latter part of 1914, except for the small field ditches. A second pumping plant was erected during 1913. The details of the improvements will be given with reference to their condition in the latter part of 1916.

LEVEES.

On the west end and the north side of this district the embankment of the New Orleans & Northeastern Railroad forms a levee with a height of about 10 feet above mean Gulf level. On the other two sides a levee was built with material taken from the outside of the district by a long-boom, orange-peel floating dredge. No muck ditch was cut under the levee, as the material was very soft, so that the top sod was well broken by the falling earth. The berm allowed was about 15 feet. This levee was raised and smoothed by handwork so that the

FIG. 5.—Sketch map of New Orleans Lake Shore Land Company tract.

top width was about 6 feet, the side slopes 2 to 1, and the elevation about 5 feet above mean Gulf level. After this treatment by hand the levee seemed to be free from seepage. The portion of the levee toward the east end of the district was raised in 1916 to about 10 feet above mean Gulf level, and the new levee then was carried directly south to connect with and become part of the lower protection levee of the city of New Orleans. This extension is not shown in figure 5. The material in these levees was placed in several layers and time allowed for each layer to dry and harden before the next layer was placed. In this way a sliding of the base of the levee into the canal was avoided, although the base will subside considerably and the material shrink a great deal in drying. On similar work elsewhere the amount of material measured in excavation is often two or even three times as much as the net section in embankment.

RESERVOIR CANALS.

A considerable portion of the reservoir canals of this district were first cut with a short-boom, bank-spud dipper dredge. As a result the canals were left in very poor condition. The banks were too soft to hold the spuds, and the

boom was too short to allow the material to be placed far enough back to be stable. Later the canals were all reexcavated with an orange-peel bucket dredge with vertical spuds, a 73-foot boom, and a hull only 24 feet wide. This allowed the maximum width of berm along the sides of the canal. This dredge went over portions of these canals as many as four times, for in spite of the long boom and wide berm the sides of the canals caved. The final cleaning out was done by a skid excavator mounted on the spoil bank of the canal. This excavator swung a one-third yard orange-peel bucket on a boom 40 feet long and was driven by a 15-horsepower internal-combustion engine. While this machine was working the water could be held at the bottom of the canal, and the soft mud which could not be picked up by the floating dredge was then solid enough to be taken out. The banks were sloped off by hand where they were not secure and the material allowed to fall into the canal to be picked up by the excavator. The first cost of this excavator was not nearly so much as that of a floating dredge suitable for doing the same work, and the excavator could do the clean-out work much more effectively. The unit price for this work was not greatly in excess of the cost of work done by the floating dredge, considering that it was of much smaller capacity. With the exception of the hydraulic dredge, the dry-land excavator is about the only practicable machine for such work.

The numerous reservoir canals on this tract give all parts of the land complete drainage. Their unusual depth, coupled with the fact that the water is held about 6 to 7 feet below the surface, gives the land a greater depth of drainage than on any other project examined. Although much care was used in lowering the water in these canals, slides and caving of the canal banks were not avoided entirely.

Ditches.

The spacing of ditches, averaging about 1,320 feet, was made to fit the subdivision of the land into 5-acre lots. The average depth of the ditches is nearly 5 feet, the top width about 4 feet, and the bottom 1 foot. The ditches are kept in very good condition, and it has been found that vegetation does not grow so readily in the bottom of a deep, narrow ditch as in a broader one not so deep. The water level is nearly always low enough in the large canals to keep the bottoms of the ditches free from water. The average length of the ditches is ¼ mile, which is about the proper length.

Prior to 1913 only a small portion of the district had been ditched. By the end of 1913 about 2,000 acres toward the eastern end had been ditched, and by the end of 1914 the ditched area had been increased to 5,400 acres. Ditching operations were continued during 1915, and by the latter part of 1916 the area was completely ditched. A large share of these ditches were cut by a wheel excavator supported on apron tractors, which cut a ditch about 4 feet wide at the top, 4 feet deep, and 18 inches wide at the bottom. The remaining ditches were cut by hand, and all were deepened by hand. The soft material which collected in the bottoms of the ditches soon after they were cut was taken out by hand also. After the soil became well-drained it solidified considerably, so that at present the ditches appear to have firm sides. However, they require cleaning at least once a year.

Pumping Plants.

There are two pumping plants on this district. The first was installed at the eastern end in the latter part of 1908. It consists of a 48-inch, cast-iron, double-suction, horizontal, centrifugal pump direct connected to a 16 by 36 inch Corliss engine, to which steam is furnished by a water-tube boiler. Coal is

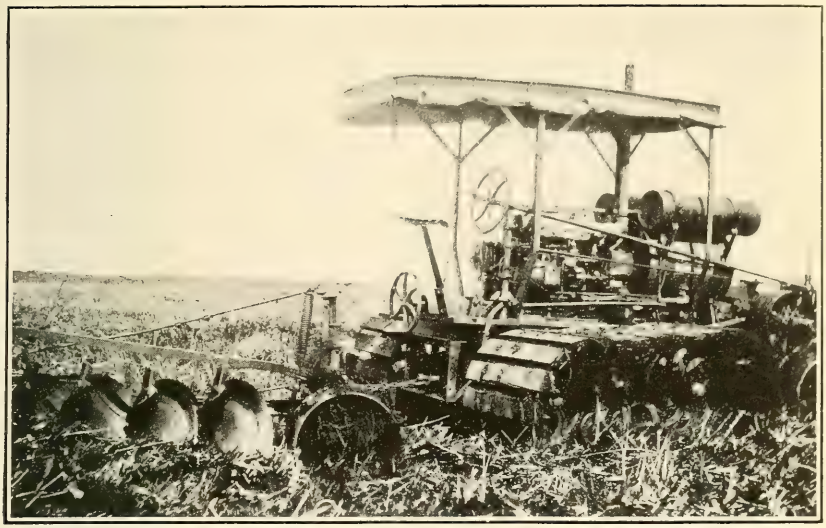


FIG. 1.—TYPE OF DISC PLOW AND TRACTOR USED IN FIRST PLOWING OF NEW ORLEANS LAKESHORE LAND CO. TRACT.

FIG. 2.—VIEW OF WET PRAIRIE BEFORE RECLAMATION.

used as fuel and is delivered by rail to a point about 300 feet from the plant. The suction pipes are rather longer than is usual in such plants; they were made so to reduce the amount of seepage from the discharge basin across to the suction basin. The ends of the suction pipes are expanded moderately, so that the entrance losses are not great. The discharge pipe discharges below low water and gives a full syphon effect, but as it is not expanded, the losses

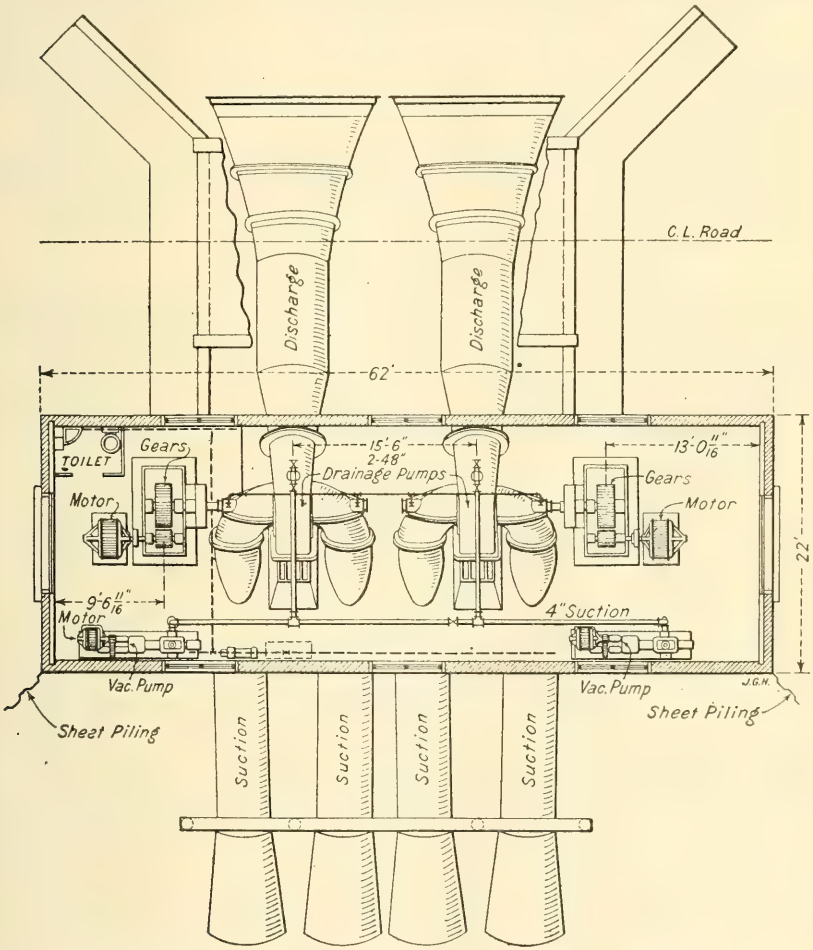


FIG. 6.—New pumping plant on the New Orleans Lake Shore Land Company tract.

of velocity head in this pipe probably are often equivalent to 2 feet of vertical lift. The direction of the water as it leaves the pipe is such that it is directed against the bottom of the discharge basin; this results in a deep hole being washed out, making it necessary that the sides of the basin be protected with a row of round piling.

As this plant was not of sufficient capacity to drain the entire area, a second pumping plant was erected in 1913 in a more central location on the north side of the district. The new plant has two duplicate units, each consisting of a 48-inch cast-iron, double-suction, horizontal, centrifugal pump, connected by

means of a herringbone gear to a 215-horsepower motor. Current is supplied by a power line from an electric company in New Orleans. The pumps are primed by means of a chamber-wheel vacuum pump driven by an auxiliary motor. The machinery is housed in a stucco-covered concrete building with structural-steel framework. The suction pipes are expanded at their ends with a long taper, so that the entrance and friction losses probably are less than 0.3 foot. The pipes are cut vertically at the end, and a row of sheet piling has been driven in the suction basin to form a funnel to direct the water into the ends of the pipes. As shown in figure 6, the pumps have an overshot discharge and are set so that the discharge openings are above high water in Lake Pontchartrain. The pipes are enlarged with a long taper so that the loss of velocity head is probably less than 0.3 foot.

The foundation of the building and machinery is supported by round piling, and the whole is inclosed by a wall of steel sheet piling driven deep into the sand. This sheet piling forms a bond with the concrete foundation.

Condition of Land for Cultivation.

From 1908 to 1913 only about 600 acres were drained. During this time only a very small amount of land was cultivated, and this was almost entirely the firmer soil along the lake. By the end of 1913, 300 acres were cultivated; during 1914, 1,700 acres; during 1915, 4,500 acres; and by the end of 1916, 6,000 acres. This land was brought in as fast as it was well drained. Usually the land ditched one year was cultivated the next. In bringing the land under cultivation the heavy growth of grass and considerable scattering brush were removed by burning, or by cutting and burning. Most of the cutting of the grass was done with power machinery. Light automobiles were rebuilt so as to have sheet-iron rimmed wheels with a width of 15 inches. These were used in drawing mowing machines mounted on wheels with wide treads. Each mowing machine was driven by a small independent gasoline engine mounted on the mowing machine itself. The land then was plowed with large disk plows drawn by tractors (Pl. I, fig. 1). After the land had been harrowed and allowed to settle for a short period it was usually possible to work farm animals on the land, provided the weather was reasonably dry and the feet of the animals were equipped with broad shoes locally known as "bog shoes." The first crop planted usually was corn. This was followed by various truck crops or corn the next year. The surface of the land rapidly became firmer, and during the second year of cultivation, except in wet weather, ordinary farm animals could work without difficulty. As rapidly as the land came into good condition it was planted in citrus trees and the cultivation of field crops continued between the rows.

DES ALLEMANDS DRAINAGE DISTRICT, DES ALLEMANDS, LA.

This tract (fig. 7) has been drained since the latter part of 1911. It lies on the western side of Bayou Des Allemands and south of the Southern Pacific Railroad. A portion of the town of Des Allemands is located in the northeast corner of the district. The land is from 1 to 2 feet above the ordinary stage of water in the bayou, and a large percentage is made up of firm silt ridges with a very thin layer of muck on the surface. Old muck-filled bayous, having widths of from 100 to 200 feet, occur at intervals. The muck in these is from 4 to 8 feet in depth. However, the land mostly is quite firm, the proportion of soft ground being about 10 per cent. The average depth of muck was from 8 to 18 inches. Except for a few scattering trees on the ridges the land originally was covered with the usual heavy growth of natural prairie grass.

LEVEES.

On one side the embankment of the Southern Pacific Railroad serves as a levee, and on the side bordering the bayou an almost continuous ridge of silt, averaging about 2 feet above ordinary water level, makes an excellent foundation for the levee. This levee was built in two layers by a floating dredge with material taken out of the bed of the bayou. The height is about 5 feet, the top width from 6 to 12 feet, and the side slopes 1½ to 1. After the first layer of material was placed in the levee a muck ditch about 3 feet deep was dug along the inside toe of the slope, and when the second layer of material was placed this ditch was filled with pure silt taken from the bottom of the bayou. This made the levee free from seepage through the base. On the other two sides the levee was located through softer land. Some years before the building of the present levee a canal had been cut along these two sides of the district. The spoil bank of this canal formed the base of the levee, although it was necessary to cut a muck ditch along the inside slope to cut off

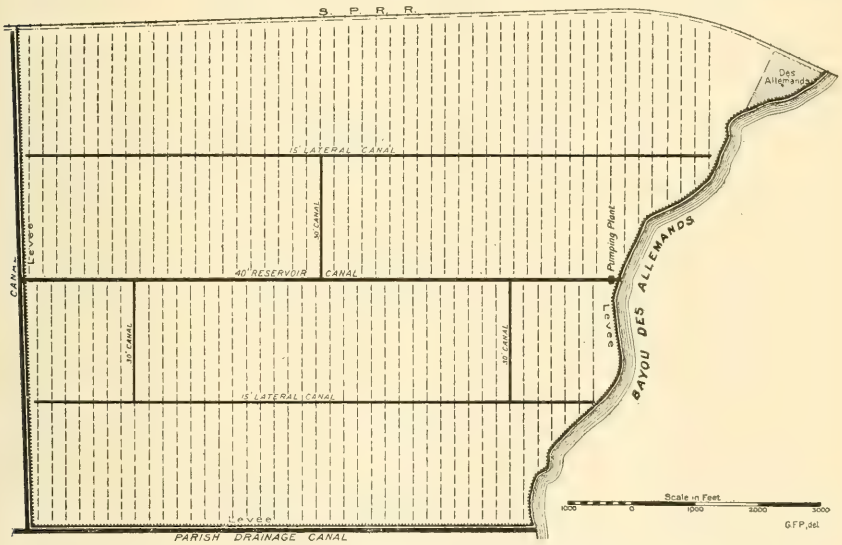


FIG. 7.—Sketch map of Des Allemands Drainage District, La Fourche Parish, La., showing arrangement of levee and ditches.

possible seepage. This portion of the levee was built up in two layers to a height of 4 feet, with a top width of from 4 to 6 feet and side slopes about 2½ to 1. The berm varies from 5 to 10 feet. Except where some old muck-filled bayous were crossed, the levee is up to the above grade. Many layers of material have been placed in these soft spots. The only method that seemed to be effective in raising this levee was to bring material in wheelbarrows from the solid banks of the bayou. After each layer was placed there was some subsidence, but gradually the top of the levee was raised. After the solid material placed in the levee reaches the solid bottom of the old bayou the levee should be free from further subsiding, except for the decay of the vegetable material in the soil, which will cause a gradual subsiding in all levees in this section.

On a portion of the levee in the northwest corner of the district very severe seepage conditions existed in 1912. Water appeared in springs as far as 100

feet from the levee. The foundation at this point was of solid silty clay, but examination showed that the ground had been honeycombed to a depth of several feet by muskrats or alligators. A trench about 14 feet deep was dug immediately along the inside of the levee by means of an orange-peel bucket dredge which floated in the outside canal. The material excavated from the trench was then dropped back into it from a height of about 25 feet by the same dredge, and the seepage was stopped entirely. No further seepage has been noticed.

Reservoir Canals.

As shown in figure 7, the reservoir canals were all cut in the interior of the district rather than along the levee. By extending the canals to all parts of the tract the necessity of small collecting ditches was eliminated. A small canal gives a much better outlet to the ditches than does the collecting ditch and is easier to maintain in good condition. Such canals can be of sufficient depth to have from 1 to 2 feet of water in them to discourage the growth of grass. These canals were cut with a small dipper dredge, and the material was deposited rather too close to the sides of the canal. This resulted in a certain amount of shrinkage in the size of the canals, and by February, 1912, there was from 2 to 4 feet of soft mud in them. A small hydraulic dredge was tried at cleaning out this mud, but was not successful owing to faults of construction in the dredge. A large orange-peel dredge was used to clear the main canal of silt in the latter part of 1913, but the lateral canals were still in poor condition. From that time until the summer of 1916 the capacity of the canals was not sufficient to bring the water to the pump rapidly enough to secure operation at full capacity, except when the stage of the water was very high. When the canal was empty at the pumping plant the water was still relatively high in the farthest corner of the district. In 1916 these canals were cleared of soft mud and enlarged somewhat by the use of a 1-yard dipper dredge mounted on an 18-foot hull and swinging a 35-foot boom. The width of the main canal now is about 42 feet and that of the small canals about 20 feet. The average depth was increased from about 5 to 9 feet. With this increased depth and width good drainage is insured for the entire district, and the pumping plant can be operated continuously until the water at the far end of the district is lowered enough to give good drainage. Prior to this clean-out work it was necessary to run the pump a few hours and then wait for the water to come in slowly to the plant.

The canals originally were smaller on this district than has become good practice, but if they had been cleared of silt early in 1913 there would have been little interference with drainage. Such clearing out of the canals should be done after they have been cut two or three years and the district drained for a year or two. The material along these canals is now quite solid, and a second clearing of the canals should not be necessary for a long term of years.

Ditches.

The spacing of the ditches on this tract is 210 feet. They are of about the usual size, 3 to 4 feet deep with a 4-foot top and a 1-foot bottom width. All discharge into the smaller lateral canals. Thus any silt which is carried along in the ditches is deposited in the small canals and does not choke up the large canals. Due to the regular shape of the district and to the good layout of canals, the ditches are all of about the same length, 2,000 feet, which has proved to be satisfactory where ditches are kept in good condition. However, in the portion of the district between the railroad and the nearest lateral canal the problem of getting the water from the far end of the small ditch into the canal

has been made harder because the land near the railroad is from 1 to 2 feet lower than that near the lateral canal. As a result the ditches have had to be 5 feet deep near the lateral canal in order to give a scant 2 feet of drainage near the railroad. While the surface of most all the prairie lands is nearly flat, it is best to take advantage of the natural slopes in laying out the field ditches.

Ditching operations were started in 1911 and continued through the following years as the land was desired for cultivation. All of the land between the main reservoir canal and the railroad had been drained in 1915 with ditches spaced 210 feet apart, and the land on the other side of the main canal had been partially drained with ditches spaced about 840 feet apart. As soon as this land is needed for cultivation it will be ditched completely.

Pumping Plant.

The pumping plant is located about 300 feet back from the bayou front, on a leveed outfall canal. This location was selected that advantage might be taken

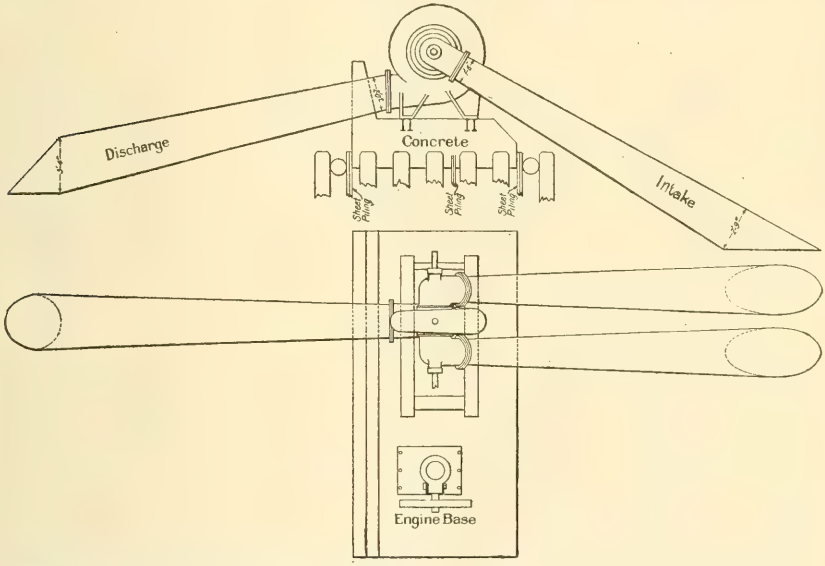


Fig. 8.—Sketch plan and elevation of one unit in pumping plant on Des Allemands Drainage District.

of a firm ridge of silt as a foundation for the machinery. The arrangement and character of the foundation are shown in figure 8. There are two duplicate units, each consisting of a 24-inch, cast-iron, double-suction, horizontal, centrifugal pump, direct connected by means of a flexible coupling to a 12 by 12 inch, vertical, slide-valve steam engine. The suction and discharge pipes are tapered their entire length, so that the area of the end of the intake is four and one-half times and the area of the discharge pipe three times that of the discharge opening on the pump. This enlargement of the pipes probably reduces the friction and velocity head losses to less than 0.5 foot, while if they were not enlarged the losses would amount to nearly 4 feet. These pumps operate efficiently, as everything within reason has been done to cut out unnecessary losses. Steam is furnished by two Scotch marine boilers, burning fuel oil. This type of plant is reliable and easily operated, but uses considerably more fuel oil than does the best type of steam engine or an internal-combustion engine. Both units have been run for periods of four or five days without stopping.

Condition of Land for Cultivation.

A considerable area on this tract was firm enough to plow with ordinary farm animals. The muck was only about 8 inches deep, and the material underneath was solid and sandy. The grass was burned off and the land then plowed with large disk plows. In addition, both round-wheel and apron-wheel tractors were used to pull gangs of disk plows which broke up the ground in an excellent manner. The ground then was pulverized with a disk harrow and planted in corn. Even on the softest of the land, after one good plowing and subsequent smoothing by tools drawn with the tractors, ordinary farm animals were used to cultivate the crop. After the second year of cultivation the shallow muck had become so mixed with the underlying soil as practically to disappear. Even the deeper muck is becoming compacted rapidly into a firm soil. By the end of 1913, 250 acres were cultivated; in 1914, 600 acres; in 1915, 800 acres; and in 1916, about 1,000 acres. The land, which was drained by ditches 840 feet apart, was partially utilized for pasturing cattle.

GUEYDAN DRAINAGE DISTRICT, SUBDISTRICT NO. 1, GUEYDAN, LA.

This district, containing 5,600 acres, is the first one developed in the southwestern part of the State. The general nature of the soil and other natural conditions already have been described. The elevation of the surface is between 1 and 3 feet above mean tide level, and the slope of the surface is from north to south. This tract is typical of the harder prairies of this section as compared with those of the softer type immediately along the rivers of this part of the State (Pl. 1, fig. 2). Work was begun on this district in June, 1911, and the pumping plant was started in March, 1912. Figure 9 shows the general arrangement of canals, levees, and ditches.

Levees.

Along the north side a drainage canal had been cut some years prior to the beginning of the present work. A spoil bank of a cross-sectional area nearly sufficient to serve as a levee remained on this canal and was utilized in making the levee for this area. Along the other three sides the canal cut to get material for the levee is on the inside of the district. In cutting a canal 5 feet deep and 25 feet wide sufficient material was secured to build a levee with a height of 5 or 6 feet and a top width of 5 feet. Owing to the solid nature of the subsoil the levee subsided very little, except where some old muck-filled bayous were crossed. The berm left on most of the levee work was less than 8 feet, and no muck ditch was used under the levee. Taking into consideration the facts that the base of this levee was from 2 to 3 feet above mean tide, that the water never becomes more than 3 feet deep on the original general land surface, that the subsoil is very solid, and that the average depth of the muck is about a foot, it would seem to have been good practice in this case to place the three new levee canals on the inside of the district and thus have use of them for drainage canals, except where the old muck-filled bayous were crossed. While in general the levee has given satisfaction, even when for nearly a month the water was 3 feet deep on the surrounding prairie, yet where the levee crossed the muck-filled bayous a considerable expense was necessary to make it safe, and at these crossings the canal should have been on the outside of the district. A dipper dredge was used to place several layers of material at these weak points, until it became apparent that the levee could not be built up to the required size by such means. The depth of the bayou varied from 1 to 15 feet, with an average of about 10 feet. The water pressure from the outside forced the levee into the interior canal. A railway trestle was built along the

center line of the levee, and heavy clay was hauled in and dumped into the bayou until the levee was built up sufficiently high. While the weight of the clay was sufficient to force it down through the muck to the bottom of the bayou, the presence of the muck caused the clay to slide laterally and made it necessary to reconstruct the trestle before the levee was finished. If the muck had been removed from the site of the levee before the clay was dumped it would have made construction easier.

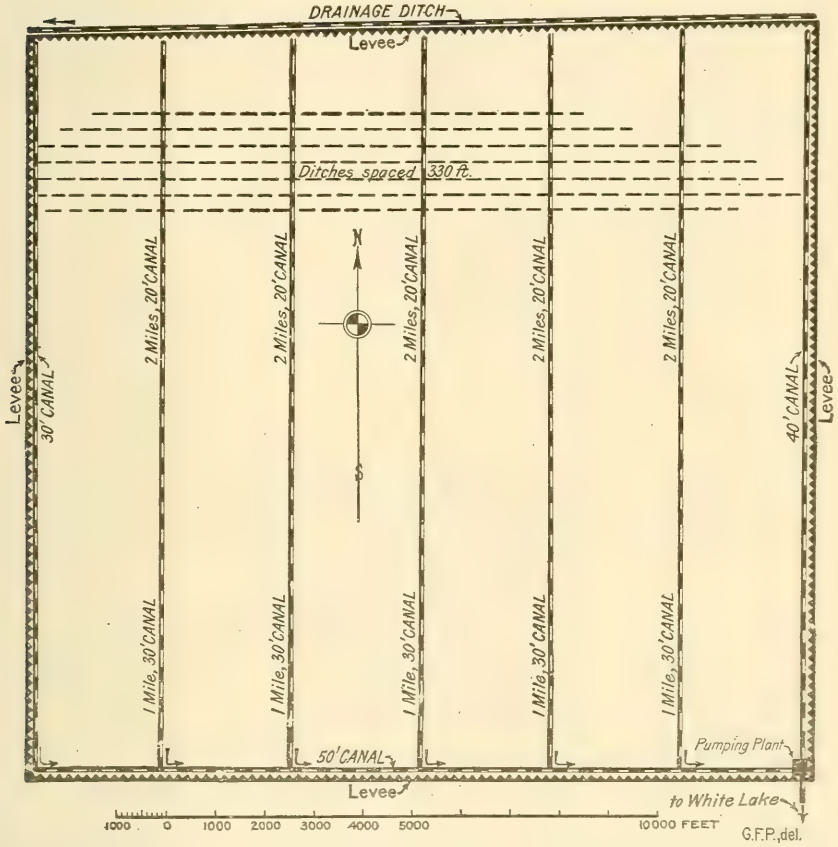


FIG. 9.—Sketch map of Gueydan Drainage District, Subdistrict No. 1, showing ditches and levees.

RESERVOIR CANALS.

In addition to the canals that border the district, collecting canals were cut every half mile. (See fig. 9.) These were from 8 to 9 feet deep and the main reservoir canal from 10 to 12 feet deep. The canals have maintained their original widths and have very little soft mud deposited in the bottom. Their banks have stood perfectly, although a considerable amount of boat traffic has been going on. They are deep enough for navigation, even after the water is lowered sufficiently to drain the land. This interior navigation has been of considerable advantage in the farming operations. In addition, the unusually large storage capacity has furnished a water supply with which to irrigate the rice crops.

Ditches.

Lateral ditches were cut with an apron-traction ditcher at a uniform spacing of 330 feet and 1,320 feet long. These machines worked in from 1 to 3 feet of water. Owing to the solid nature of the subsoil the apron wheels did not sink into the ground to any great extent. Because no openings were left by the dredges in the spoil bank along both sides of the canals, cutting by hand was necessary to connect each ditch, and as the spoil banks frequently were 10 feet high, the expense was considerable. However, the frequent and regular lateral canals made it an easy matter to install an efficient system. The ditches were cut a little more than 4 feet deep, with a top width of 4 feet and a bottom width of 1½ feet. The ditches have maintained their size and shape very well in the firm subsoil of this district and have filled badly only in the deep, soft muck in the old bayous.

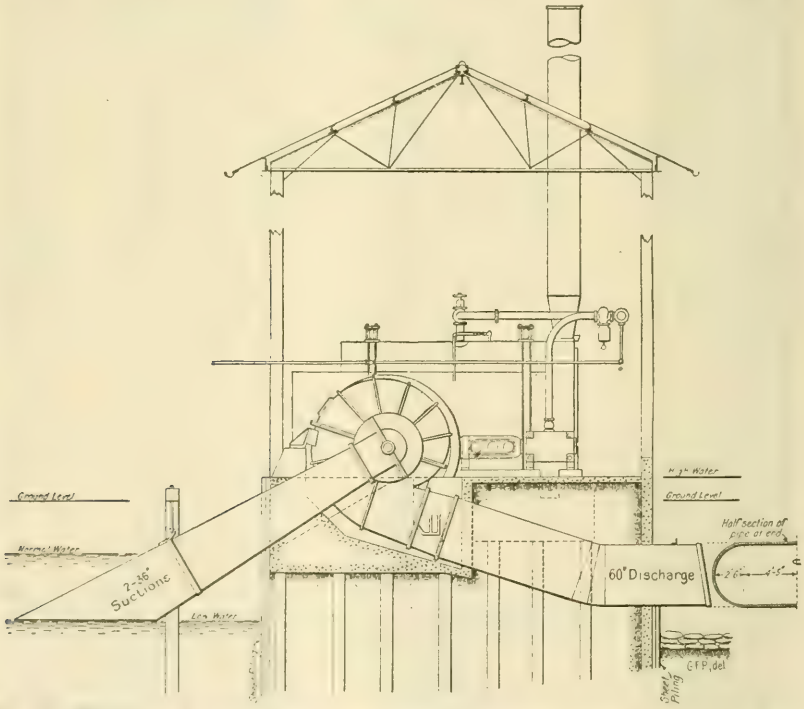


Fig. 10.—Elevation of pumping plant on Gueydon Draining District, Subdistrict No. 1.

Pumping Plant.

This fireproof plant was located in the corner of the district, so that it would be near an outlet canal to be dug to White Lake, about 6 miles to the south. By placing the plant in the middle of the south side of the district the length of canal to the farthest portion of the district could have been reduced from 6 to 4½ miles.

There are two duplicate units, each consisting of a 54-inch, cast-iron, double-suction, horizontal, centrifugal pump, direct connected by a solid shaft to a 16 by 36 inch Corliss engine. As shown in figure 10, the suction and discharge pipes are so designed that the friction and velocity-head losses are small, less than 0.5 foot on test. Steam is furnished by two return tubular boilers burning fuel oil. The feed water is heated before entering the boiler. The machinery is

mounted on a concrete foundation supported on piling driven in unusually hard subsoil. This plant was found of ample capacity to drain this area of 5,600 acres, and an additional area of 2,000 acres was placed tributary to the plant. The building inclosing this machinery is a frame of structural steel, covered with heavy corrugated iron.

Condition of Land for Cultivation.

Owing to the solid nature of the subsoil, cultivation was started on this area a few weeks after the pumping plant had removed the water. By April, 1913, a year after the pumps were started, about 500 acres were plowed. A gang of moldboard plows, drawn by a heavy apron-wheel tractor, was used. After the tough sod had been pulverized with a tractor-drawn disk harrow the land was cultivated successfully with ordinary farm animals and machinery. On the deeper muck near the south end of the area, plowing was done with a large disk plow drawn by tractor. In 1914 a little more than 600 acres were cultivated, in 1915 about 1,000 acres, and in 1916 about 1,500 acres. Most of this cultivated land was planted in rice, and the water for irrigating it taken from the interior reservoir canals. During the months when water was used for rice irrigation (June to August, inclusive) the amount of water that the large drainage pumping plant took out of the interior canals was very small. When the water was drained off the rice field, preparatory to cutting, a considerable volume of water had to be pumped.

RESULTS OF INVESTIGATIONS OF RECLAIMED TRACTS.

Table I gives a summary of all the details of reclamation and the prominent natural features on the areas already described, with corresponding data on a number of other districts. No detailed descriptions of these latter districts will be given, as conditions on them are in general similar to those on the districts already described. In explanation of this table the following notes are given:

In calculating the percentage of land that is in lateral ditches it was considered that for each ditch a strip of land 6 feet wide is lost to cultivation.

The reservoir capacity, in inches of depth over the whole area, includes the capacity of all canals between the general surface of land and the water level 5 feet below the surface.

The pumping plant capacity was based on a velocity of 12 feet per second through the discharge openings of the pumps.

FACTORS AFFECTING DRAINAGE BY PUMPING IN SOUTHERN LOUISIANA.

While the detailed descriptions of the four typical districts and the data in Table I give a general idea of the drainage problems and the methods used in solving them, it is believed that it will be of service to point out some of the usual faults of plan and construction and to describe the best methods being used in the design and construction of the drainage works.

INVESTIGATIONS TO BE MADE BEFORE RECLAMATION.

Before attempting to reclaim any body of wet prairie land, the following points should be investigated thoroughly:

(1) The depth and character of the muck;

(2) The character of the underlying silt;

(3) The elevation of the land above ordinary stages of the water in the surrounding lake and bayous;

(4) The ordinary and extreme variation of the water level in these lakes and bayous;

(5) The elevation of the ordinary and maximum storm tides and the rate of rise and fall;

(6) The amount and character of sunken timber and stumps;

(7) The character of the timber or grass on the surface; and

(8) Transportation facilities.

In addition, the topographic features of each district should be investigated in detail by a careful field survey, and a complete and definite plan and estimate of cost worked out by a competent engineer. The work should be constructed under competent engineering supervision and should be of a permanent nature, since the need for the improvements is permanent.

AREA OF THE DISTRICT.

Although topography has a large influence in many localities in fixing the area of a reclamation district, there are many large bodies of land of such a character that the size of the unit would be determined almost entirely independently of topographic conditions. In order to make clear the conditions governing the determination of the most desirable size of unit, the respective advantages of the small and large districts will be enumerated. The principal advantages of the small unit are:

(1) Short internal drainage canals with small losses of head, and the consequent low lift;

(2) Short haul to outside water transportation;

(3) Small area affected in case of failure of protection levee;

(4) Small capital involved; and

(5) Short time required to place land under cultivation and early realization on investment.

districts in soul

Reservoir capacity.	Pumping capacity in 24 hours.	
Inches.	*Inches.*	
0.88	1.23	
2.20	.93	
.70	1.06	
.81	1.69	
.50	1.25	
.40	2.15	
.67	1.91	
.50	1.50	
.....	1.40	
.66	1.60	
.50	1.42	
.34	.95	
.66	1.58	
.35	1.33	
.66	.....	
.66	1.58	
.42	1.01	
.....	1.28	
1.17	1.35	
.42	1.60	
.63	1.75	
.60	1.44	
.97	1.81	
.....	1.04	
.90	1.17	
.....	1.03	
.90	2.55	
1.00	1.38	
.28	1.56	
.66	1.62	

TABLE I.—*Summary of natural conditions and drainage features on thirty reclamation districts in southern Louisiana.*

No.[1]	District.	Parish.	Town.	Area.	Original depth of muck.	Elevation above mean Gulf.	Height of storm tides.	Height of levees.	Spacing of laterals.	Size of laterals. Top.	Size of laterals. Bottom.	Size of laterals. Depth.	Length of laterals.	Depth of water table.	Land in ditches.	Land in canals.	Reservoir capacity.	Pumping capacity in 24 hours.	Pumps.	Engines.	Boilers.	Fuel.	Work begun.	Date of first pumping.	Date of first cultivation.	Cultivated in 1916.	Remarks.
				Acres.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Per ct.*	*Per ct.*	*Inches.*	*Inches.*								*Per ct.*	
4	Chevron drainage district, subdistricts Nos. 1 and 2	Vermilion	Florence	7,400	0–3	1–3	0	5	330	4	1½	4	1,320	2	1.8	1.5	0.88	1.23	2 54-inch centrifugal; 2 30-inch centrifugal	2 Corliss; 1 Corliss, compound	Return-tube; Water-tube	Oil; Wood	1911	1912	1912	20	
5	[illegible] drainage district	St. Mary	Morgan City	16,000	0–3	1–7	5	6	165	4	1½	4	1,320		3.6	3.8	2.20	.93	1 48-inch centrifugal; 1 72-inch centrifugal	1 Lentz	Oil	Oil	1911	1912	1913	30	
6	Upper Terrebonne drainage district	Terrebonne	Houma	4,240	1–5	3–7	0	3	165	4	1	3	1,320		3.6	1.4	70	1.06	6 24-inch centrifugal; 2 48-inch screw	1-horse-power; 2-horse-power oil-burning		Oil	1912	1916	1917	10	
9	Lafourche drainage district No. 12, subdistrict No. 4	Lafourche	Raceland	4,190	0–4	3 7	0	5	330				1,400; 2,000			1.5	81	1.69	2 48-inch centrifugal	2 125-horsepower oil-burning		do	1914	1915	1915	2	
10	Lafourche drainage district No. 12, subdistrict No. 3	do	do	2,250	1–3	0–3	0	5	200	4	1½	4	1,200; 2,000	2–3	3.0	.8	.50	1.25	2 30-inch centrifugal	2 slide-valve	Return-tube	do	1903	1910	1910	100	
11	Lafourche drainage district No. 12, subdistrict No. 1	do	do	835	0–2	0–3	0	3	200	4	1½	4	1,200; 2,000	2–3	3.0	.6	.80	2.15	2 24-inch centrifugal	2 40-horsepower oil-burning		do	1907	1908	1909	100	
12	Lafourche drainage district No. 12, subdistrict No. 2	do	do	940	1–3	0–3	0	5	200	4	1½	3	1,200; 2,000	2–3	3.0	1.3	.67	1.91	2 24-inch centrifugal	2 50-horsepower oil-burning		do	1907	1908	1909	100	
14	Smillport Plantation	do	Lockport	647	0–2	2–2	0	4	165	4	1	3	1,320	2–2½	3.6	.6	.50	1.00	2 Mouse	2 slide-valve	Return-tube	do	1907	1908	1908	100	
17	Lafourche drainage district No. 13, subdistrict No. 1	do	do	2,000	0–2	0–4	0	4	200	4	1	3	1,200; 2,000	2–2½	3.0			1.40	2 30-inch centrifugal	2 50-horsepower oil-burning		do	1914	1915	1916	50	
17	St. Charles municipal drainage district No. 1	St. Charles	Paradis	9,860	0–3	1–3	0	5	200	4	1	4	1,330	2–3	3.0	1.2	.66	1.60	2 78-inch screw	2 piston-valve	Return-tube	Wood; Oil	1911	1914	1916		
18	St. Charles drainage district No. 1	do	do	5,340	0–2	0–3	0	4	165	4	1	3	1,320	2–2½	3.6	.9	.50	1.42	2 36-inch centrifugal	2 slide-valve	do	do	1910	1911	1915	10	
19	Lafourche drainage district No. 6, subdistrict No. 1	Lafourche	Des Allemands	1,880	0–2	0–2	0	3	200	4	1	4	2,000	2–3	2.9	1.0	.44	.95	2 24-inch centrifugal	do	Marine	do	1910	1911	1912	55	
23	Delta Farms drainage district No. 4	do	Larose	2,950	2–3	0–2	3	5	165	4	1	4	1,320; 2,640	2–3	3.6	1.0	.66	1.58	2 36-inch centrifugal	do	Return-tube	Coal	1913	1914	1915		
24	Delta Farms drainage district No. 1	do	do	840	2–3	0–2	3	5	165	4	1	4	2,640	2–3	3.6	.6	.35	1.33	1 15-inch centrifugal; 1 18-inch centrifugal	2 40-horsepower gasoline		Gasoline	1910	1911	1913	100	
25	Delta Farms drainage district No. 2	do	do	2,730	2–3	0–2	3	5	165	4	1	4	1,320; 2,640	2–3	3.6	1.0	.66		1 36-inch centrifugal	1 slide-valve	Return-tube	Coal	1910	1911	1913	22	
26	Delta Farms drainage district No. 3	do	do	2,560	2–3	0–2	3	5	165	4	1	4	1,320; 2,640	2–3	3.6	1.0	.60	1.58	2 36-inch centrifugal	2 slide-valve	do	1911	1913	1914	16	
28	Lafourche drainage district No. 9, subdistrict No. 1	do	Golden Meadow	1,180	0–2	0–2	5.5	5					2,640			.8	.42	1.01	2 24-inch centrifugal	2 50-horsepower oil-burning	Oil	Oil	1912	1915			
29	Pontchartrain drainage district, subdistrict No. 1	St. Charles	Lafourche	900	0–2	0–3	12	5								2.1	1.17	1.25	1 24-inch centrifugal	1 slide-valve	Return-tube	Coal	1913	1914	1914	30	
30	Kenner drainage district	Jefferson	Kenner	2,100	0–1	1–3	6	7								2.1	1.17	1.33	2 35-inch centrifugal	2 slide-valve	do	Wood	1913	1914			
31	Willswood Plantation	do	Waggaman	2,800	0–4	2–9	0	8	100; 400	3	1½	3	2,400	2	2.4	2.0	.42	1.06	1 rotary, 1 Mense; 1 36-inch centrifugal	1 automatic; 1 slide-valve	Water-tube	Oil	1906	1907	1897	100	
32	New Orleans Netherlands Co. drainage district	St. Charles	New Orleans	2,130	1–3	1–3	0	4	240	4	1	1		2–3	3.0	1.2	.13	1.73	1 24-inch centrifugal; 1 30-inch centrifugal	1 50-horsepower oil-burning		do	1912	1913	1914		
33	Jefferson drainage district No. 3	Jefferson	Lafitte	5,000	0–4	1–3	3.0	5	220	4	1	4	2,000	2–3	2.7	1.1	.60	1.44	2 48-inch centrifugal	2 Corliss	Return-tube	do	1911	1913	1914	15	
34	N. O. Lake Shore Land Co.		Orleans	6,930	0–12	1–3	6.0	10	165	5	1	5	1,320	3–4	3.6	1.2	.97	1.81	1 48-inch centrifugal	1 Corliss, 2 electric motors	Water-tube	Coal	1908; 1913	1908; 1913	1909	85	
37	Plaquemine-Jefferson drainage district	Plaquemines; Jefferson	do	5,750	0–3	1–9	0	4										1.04	1 48-inch and centrifugal; 4 76-inch	5 Corliss, compound	do		1912	1915		20	Part of land cultivated before present improvement.
38	Reclamation district No. 1	Plaquemines	Poydras	2,500	3–4	0–1	6.5	7	165	3	1	3	660	2	3.6	1.5	.90	1.17	1 24-inch and 1 36-inch centrifugal	2 slide-valve	Return-tube	Coal	1910	1912	1912	30	
42	Bayou Terre Aux Bœuf drainage district, subdistrict C	St. Bernard	Alluvial City	7,000	0–4	0–3	10.0	6										1.03	2 48-inch centrifugal	2 Corliss			1913				
43	Venice drainage district	Plaquemines	Venice	1,100	0–3	1–4	7.0	5	100; 200	3	1	3	2,000	2	4.0	1.7	.90	2.55	2 30-inch centrifugal	2 slide-valve	Return-tube	Coal	1914	1915	1915	20	Do.
44	Buras drainage district	do	Buras	2,038	0–2	1 5–5	7.7	6									3.0	1.00	1 48-inch screw; 1 36-inch screw	1 100-horsepower, 1 50-horsepower oil-burning		Oil	Under contract			25	
46	Jefferson drainage district No. 4, subdistrict No. 4	Jefferson	New Orleans	1,800	0 12	0–2	6.0	6									3	.28	1 36-inch screw	2 50-horsepower oil-burning		do	1913	1916			
47	Lafourche drainage district No. 20, subdistrict No. 1	Lafourche	Cut Off	2,900	2–3		4.5	7	165	4	2	3	1,320		3.6	1.1	.68	1.63	2 36-inch screw	2 150-horsepower oil-burning		do	1916				Under construction.

[1] For locations and status of districts see figure 1.

The advantages of the large district over the small one are:

(1) Low cost of levees per acre of protected land;

(2) Possibility of using natural ridges in part for levees;

(3) Possibility of using natural bayous and lakes as part of the interior drainage system;

(4) Use of efficient machinery due to more continuous operation of the pumping plant;

(5) Low first cost, per unit of area, of pumping plant due to centralization of equipment and smaller relative capacity;

(6) Low unit operating charges on pumping plant.

The benefit of low lifts on the smaller districts is offset by the advantages in using more efficient machinery for the high lifts on larger districts and the less cost per acre of machinery. Unit labor charges for plant operation also are much less on the larger districts. Although the haul to water transportation on large districts is necessarily greater, with larger interests involved, good roads can be built and maintained economically. Since the cost of levee per acre of reclaimed lands is so much less on a larger district, a better class of levee can be constructed, resulting in an increased margin of safety. While the small district can take advantage of natural ridges at times, this usually is possible only on one or two sides, and only in rare cases can the small district include natural bayous and lakes as reservoirs. The advantages, in the case of the small district, of the small capital involved and the earlier return on the investment may be offset easily by the increased cost per acre for construction of levees, canals, and pumping plant. The operation and maintenance charges, which are a perpetual tax on the land, also are higher on the small district, and from the standpoint of the individual owner and cultivator of the land the advantage is all with the large district.

Just what is the most economical size of district has not yet been determined; it is a matter that is greatly affected by local conditions. However, it is the consensus of opinion among engineers engaged in this work that districts containing less than 2,000 acres are not at all desirable. An area of about 5,000 acres has been found very satisfactory under average conditions. Where large lakes and bayous can be included as reservoirs and drainage channels and natural ridges can be taken advantage of for levees, a district well may be much larger than 5,000 acres.

LEVEES.

The location of a levee influences its design, construction, and maintenance, as well as its usefulness to the district. Unlike levees along our rivers, those along the average reclamation district in this section have not been located according to the topographic conditions, but rather according to property or land lines. This has usually resulted in regularly shaped districts and minimum length of levee for area inclosed; but the cost of construction and maintenance per unit of length has often been much greater than if some attention had been paid to topography. Throughout most of the wet prairie there are winding bayous that have along them solid ridges of silt that average from 1½ to 2 feet above general ground surface. In other places the bayous are filled in entirely, and there have been left ridges of silt having widths of from 200 to perhaps 1,200 feet, with the usual elevation of 2 feet. If the levee be located on a solid ridge, the material will be more stable and impervious and the levee can be made of less cross-sectional area than would be necessary if it were located in the soft prairie. Construction, also, will be easier and cheaper and the expense of maintenance much less. Where levees are to be

built to protect areas of marsh land on the immediate coast line, a strip of land at least a quarter of a mile wide should be left as a foreshore to break the force of the wave. Where the exposure is particularly great, this strip of land should be wider.

If the levee be located on firm land and the land outside the levee never is flooded for more than a few days, it will, in some cases, be advisable to dig the canal from which material is taken for the levee on the inside of the district and to utilize this canal as a drainage channel. In such cases the berm should be especially wide, at least 20 feet. In general, this type of construction is not recommended. If the levee canal be placed on the outside of the district it can be utilized for navigation.

The design of the levee will depend largely on local conditions. Its top should be from 2 to 4 feet above the highest stages of water in the surrounding lakes and bayous, depending on the area of land protected and the probability of previous high-water marks being exceeded. Where the water to be kept out is due to storm tides in the Gulf, the height of the levee should be determined only after very careful investigation of all surrounding conditions has been made and the probable highest stage estimated, taking into consideration the local conditions as outlined under the section on Tidal Overflow. If the levee is located in an exposed locality its top should be about 4 feet above the estimated highest water. A minimum height of about 4 feet should be used through the soft prairie section, as anything less is not likely to prevent seepage satisfactorily; for when located on a ridge the water will stand against a levee only for short periods, while if located in a soft prairie the water will be in continuous contact with the lower foot or two of the levee. In places exposed to strong wave action the height should be sufficient to provide for the break of the waves; in addition, some provision should be made for protecting the levees from their erosive action. This protection could be secured by planting willows some distance in front of the levee.

Where the levee is located on a ridge the top width may safely be made 4 feet, with side slopes 2 to 1. A levee of this type is often built with wheelbarrows, and although the unit cost for this method is quite high, being about 18 cents per cubic yard, the total cost is considerably less than if the work were done with the usual floating dredge. Yard for yard, the dredge would, of course, handle the material much cheaper, but the excavation would be more than would be necessary for the levee. This objection would be overcome if the dredge were building a levee along the bank of a bayou of sufficient depth to float the machine, or if a reservoir canal were being excavated within the district, the waste bank to be used as a levee.

Where the levee is located in the soft prairie the top width should average about 6 feet. The side slopes should be about 3 to 1; in fact, if the material is very soft it will not take a much steeper slope than this during construction. As the material always becomes more stable after being placed in the levee, no trouble should be expected from slides after it begins to dry in place.

The berm along the base should be at least 15 feet wide. Where the soil is exceptionally soft this should be made as much wider as practicable, at least 20 feet. The width of berm will of course depend somewhat upon the nature of the machinery used in construction.

Some type of floating dredge should be used in the construction of most levees. In heavily timbered sections, or where old submerged stumps are numerous, the dipper dredge will work to the best advantage; but in the open, grass-covered prairie the orange-peel-bucket dredge has many advantages.

Owing to the longer boom and narrower hull, the latter type of dredge is able to leave a wider berm along the toe of the levee. It also is better able to sort the material placed in the base of the levee; for the top layer of muck can first be taken out of the canal, and then the silt underneath, while the dipper dredge will usually cut up through both the silt and the muck and mix them. The levee should usually be constructed in several layers, for both the base and the material are likely to be so soft that subsidence will be too great if a height of more than a few feet is attempted. This yielding of the base will often cause the side of the canal to cave, especially if the berm be small.

The total subsidence and shrinkage of the material in the levees often amounts to 50 per cent, and in special cases is as great as 80 per cent of the bulk of the material, as measured in excavation. Practically all of the subsidence and a part of the shrinkage takes place during construction, so that the remaining change in height can be taken care of by maintenance. When a large percentage of muck is placed in the levee the shrinkage will be great for a number of years, due to the decay of the vegetable material in the muck.

The orange-peel bucket is especially suitable for placing several layers in a levee. After a canal is once cut in the soft prairie a considerable depth of soft mud that makes very poor levee material will be in the bottom. The dipper dredge, when working in such a canal, will place a large percentage of soft mud in the levee; while an orange-peel bucket, when dropped forcibly, will penetrate the undisturbed silt below and fill with it, the soft mud running off when the bucket is raised.

If the site of the levee is along a solid ridge above ordinary water level, no special precautions need be taken to prevent seepage, although all stumps and logs should be removed from the site and a shallow ditch should be cut to insure a perfect bond between the ridge and the levee. On the other hand, if the levee is through very soft prairie, the material dropped from the dredge will penetrate the muck and form a good bond with the underlying silt. It is on the portions where the muck is thick and turfy in character that particular pains must be taken. A ditch cut along the center line of the levee before the dredge starts working is of no special benefit, as the material placed back in the ditch by the dredge will be largely muck, although it is true that this treatment will break the continuity of the muck and help to cut out a portion of the seepage. A better plan is to wait until the first layer of material has been placed by the dredge and then cut a ditch along the toe of the slope of the levee opposite the dredge and refill it with impervious silt dredged from the bottom of the canal. This will insure a good bonding of the material and is a necessary part of the construction. At times old muck-filled bayous will be encountered which must be closed with levees. In such cases the quickest, and quite often the cheapest, way to insure that the levee hold its grade line is to drive two rows of sheet piling across the bayou at the proper spacing. These rows should be tied together with rods and the fill made between them.

The average unit price for dredge-built levees, where the material is measured in excavation, has been from 6 to 8 cents per cubic yard, depending on the amount of timber and stumps encountered. Large amounts of such work have been done at an actual cost, to the owners of the dredge, of less than 3 cents per cubic yard. Since it requires from one and one-half to three times as much material in excavation as finally appears in the settled embankment, the contract price would vary from 10 to 25 cents per cubic yard of such embankment.

If the levee is to be brought to a regular cross section by hand or machine work, a small additional charge should be made. In general, however, the levees, as built, have not been surfaced after the dredge work is finished,

although it would be better if the levee were smoothed off, seeded to Bermuda grass, and pastured. This will aid in closing up the cracks that form through the gradual shrinking of the material. In certain cases it may become necessary to plow and harrow the levee in order to close up these cracks. If this is not done, and if a rapid rise of the water outside the district occurs after a prolonged dry period, the seepage through the body of the levee will be very great. In certain cases this seepage through shrinkage cracks has overtaxed the capacity of the pumping plant. The grazing of the levee provides a cheap and profitable method of maintenance and will discourage the action of burrowing animals.

INTERIOR DITCH SYSTEMS.

Rainfall and seepage cause an accumulation of water within the levee district that must be collected by a system of ditches and canals, led to a central point and discharged over the levee by means of pumps. Numerous arrangements of ditch systems have been used with varying degrees of success, depending on how well the work was executed and maintained. The best of present practice is to make this system consist of small ditches which can be cut and maintained by hand, discharging into reasonably large canals which can be cut and maintained by means of a dredge. The use of intermediate-sized ditches, say, 6 to 8 feet wide and 5 or 6 feet deep, has not proved successful on these districts. Since such ditches are free from water most of the time, grass grows very readily in the bottoms. Moreover, they are too large to be cleaned by hand easily and are too small to allow the use of a dredge.

Field Ditches.

On the typical wet-prairie reclamation district the land is so nearly level that a regular layout of field ditches is desirable rather than a location designed to take advantage of such slight surface slopes as may exist. The ditches should be cut in parallel lines and at such a spacing as will correspond with the character of the land. As shown in Table I, the spacing of ditches has varied from 100 to 330 feet. The degree of drainage required in these soils depends somewhat on the crop. Where rice is grown, a spacing of 330 feet has proved ample for soils in southwestern Louisiana. Where very valuable truck crops are to be grown, a spacing even less than 100 feet might be required. In general, a spacing of about 200 feet has been found satisfactory for general field crops, such as corn and sugar cane. As the lands are cultivated and compacted, and the loose vegetable material in the soil decays, a spacing of less than 200 feet may be necessary. A ditch 4 feet deep, 4 feet wide at the top, and about 1½ feet wide at the bottom has been found to be the most economical to cut and maintain by hand. Ditches of this size are of ample capacity, unless they become choked with weeds or are required to bring the water too far. Since the land is practically flat, flow in such a ditch is caused only by the piling up of the water in the upper end of the ditch. If the ditch is too long, this will bring the water too close to the surface of the land. In practice it has been found that in flat land such ditches can be made one-fourth mile long with good results, and they have worked fairly well in a few cases at a length of one-half mile. However, this latter length is not recommended, as the ditch must be maintained in almost perfect condition in order to give satisfactory drainage. In most cases where the small field ditches are one-half mile long they have not proved satisfactory.

While this type of ditch can be cut in this section with hand labor for from 5 to 7 cents per cubic yard, a large proportion of the work has been done with

machinery. Where a large body of land is to be ditched rapidly a more rapid means than handwork is desirable, even where the cost by machinery is about the same or even greater. Wheel excavators mounted on apron traction and driven by gasoline engines have been very successful. They cut a very satisfactory ditch and place the excavated material farther back from the ditch than is possible by hand. Where there is much timber or stumps these machines can not be used. Machines can not be used on the softer prairies until the land has been surface drained for some months and become somewhat solid. A common practice has been to cut ditches at a spacing of about 1,000 feet by hand, the resulting drainage making it possible to use the machine soon afterwards to cut the remaining ditches. Hundreds of miles of ditch have been cut with excavators at from 3 to 6 cents per cubic yard. In one case ditches were cut with a heavy wooden-framed plow, especially built for the purpose, drawn across the strips of land between the reservoir canals by cables and pulling engines mounted on barges. These ditches were cut as soon as the pumps were started and the water drawn off the surface, which was many months before the land would have supported the ordinary wheel excavator.

Ditches in this class of land require much attention for the first year or two after cutting. A soft mud from the banks collects in the bottom, and rapidly growing weeds and grasses impede the flow of the water and aid in the silting process. The soil shrinks considerably after it is drained and cultivated, and the effective depth is soon reduced below that required. This clean-out work is done best by hand, but even that is an unsatisfactory process, the mud being too thick to run out of the ditch, but also too thin to pick up with a shovel. By selecting a time of scant rainfall, when the bottom of the ditch is nearly dry, it can be cleaned the most effectively. It is necessary to cut the grass and weeds in these ditches about twice a year, and for the first few years after first cutting they will have to be cleared of soft mud at least once a year, taking out about a cubic foot of material per linear foot. After perhaps four years, cleaning will be necessary only once in two years. The cost of maintaining these open field ditches would more than pay the interest on the extra investment necessary to tile-drain the land. In addition there would be a large saving in land and a greater convenience in farming operations. While a shallow open ditch would still be necessary to carry away the run-off from heavy rainfalls, the action of a well-laid tile drain would be much more uniform in taking away the ground water than would an open ditch, which is in good condition only for a few weeks after it is cleared of grass and weeds. It would not be possible to lay tile drains in the newly reclaimed lands, but after they have become firm a large percentage of the open ditches should be replaced by tile drains.

Reservoir Canals.

The primary requisite of the reservoir canals is that they give sufficient outlet to the field ditches. To do this they must be spaced not much more than a half mile apart and preferably should be located in parallel lines. Without too much sacrifice of regularity they should be located in the lowest ground, so that the flow of the water from the field ditch will be facilitated as much as possible. The arrangement of canals also should be such that the water in flowing from the farthest corner of the district to the pumping plant travels as short a distance as practicable.

The reservoir canal serves a two-fold purpose: (1) To take the water from the small field ditches and carry it to the pumping plant, and (2) to store up the dry-weather flow of the ditches so that the pumping plant will not need to be operated so frequently. When some of the districts examined were first

reclaimed the interior canals were too small and too shallow either to carry the water rapidly to the pumping plant or to store up water for pumping. As a result it was necessary to operate the pumping plant for a few hours almost every day, and at times of heavy rainfall the portions of the canals remote from the pumping plant were too full of water to give outlet to the ditches. These canals ultimately were made wider and deeper.

Since the land is flat, flow in the canals can result only from a piling up of water in one portion or from the lowering of the water by the action of the pumps. If the canals are small, the velocity of the water in them must be high in order to bring water to the pumps; this will mean a large surface slope and a large difference in the elevation as between the water surface at the pumps and that in the remote portions of the district. Although immediately after very heavy precipitation the water may safely stand level with the lowest land for several hours, the canals should be of such cross section that they will be able to deliver enough water to allow the pumps to be operated when the water stands at least 4 feet below the surface of the land. The surface slope of the water in a canal of this size necessarily will be small; it should be between 0.2 and 0.4 feet per mile. The minimum depth for such canals is 7 feet, and the depth should increase gradually toward the pumping plant so that the bottom shall have a slope at least as great as that of the water surface. This will allow a depth of 1 or 2 feet of water to be maintained in the canals at all times, which is sufficient to discourage the growth of weeds and grass. Experience on such reclamation districts has shown that shallow canals become choked with weeds and grass very quickly and require frequent cleaning.

Reservoir canals have been excavated with a number of types of dredge. Owing to the soft nature of the land a floating dredge is always required. Where there is considerable standing timber and sunken logs and stumps, a dipper dredge is the best machine for cutting the canals—at least for taking out the top 4 or 5 feet. It has been found best to cut the canals in two layers, allowing the banks and the material excavated the first time over to solidify before placing an additional load on them.

Where the prairie is free from stumps, or where the stumps have been taken out of the way with a dipper dredge, a long-boom, gravity-swing, orange-peel bucket dredge is a very satisfactory means of cutting such canals. This disturbs the material much less than does a dipper dredge, and the canal cut with the orange-peel bucket will be much freer of soft mud than one cut with the dipper dredge. In any case, such dredges should be equipped with vertical spuds instead of bank spuds, which have caused serious caving on all canals where they have been used in the soft prairie land. The berms between the side of the canal and the spoil bank should be at least 10 feet and preferably 15.

The hydraulic dredge is perhaps the most satisfactory means of cutting interior canals. The top 4 feet might first be taken off with a dipper dredge, thus forming low retaining walls to keep the material placed by the hydraulic dredge from running back into the canal. Such canals will be free from soft mud, and the side slopes can readily be controlled. While the side slopes of the canals are limited more or less by the character of the excavating machinery, if operated with care a dipper dredge can easily give a slope of ½ to 1 on the canals. If the material is placed well back from the banks this slope has been found to be satisfactory. The excavating of such canals has been done by dredges owned by the district at a cost per cubic yard of from 3 to 5 cents. The work has frequently been contracted for at from 6 to 8 cents.

PUMPING PLANT.

The drainage of low-lying wet lands by means of pumps is described in a publication of this office.[1] The bulletin discusses the general practice of land drainage by means of pumps and deals especially with conditions in the upper Mississippi Valley. The general nature of this method of drainage in southern Louisiana is much the same as described in that bulletin, but there are many differences in detail that deserve mention. These differences affect chiefly the capacity and operation of the pumping plant.

Necessary Capacity of Plant.

The general method of operation of plant in southern Louisiana is far different from that in the northern latitude, so before discussing in detail such rainfall and run-off records as are available it might be well to describe the usual method of operation. In southern Louisiana farming operations are conducted every month in the year. While general field crops are growing only about 9 or 10 months, the field must be kept sufficiently well drained to permit cultivation at any time. The bulk of the heavy plowing is done during what are ordinarily called the winter months. The need of the pumps, therefore, is more or less continuous—that is, the run-off at any time of the year must be taken out promptly.

During the first few years after construction the maintenance charges on reservoir canals are quite high. A certain amount of bank caving occurs, and a large quantity of semifluid mud comes in through the field ditches from the soft land. The velocity of flow in the canals is not sufficient to transport any appreciable amount of this soft mud to the pumping plant. Unless the water is lowered very slowly when the pumps are first started, the tendency of the soft subsoil to flow into the canals will become apparent. In one case where the water was lowered rapidly the canal became several feet narrower and shallower within a week or two. While in this case the spoil banks were too close to the sides of the canal, and no doubt contributed to the rapid shrinkage of section, the shrinkage was due mostly to a rapid lowering of the water. Canals cut by hydraulic dredge will not be so susceptible to shrinkage, as the weight of the excavated material does not rest on the banks.

This rapid filling of the canals when the land is first drained makes it good practice to excavate the canal somewhat larger than is desired for the permanent section. If this be done, the canal will not require cleaning until the land has had time to solidify and the soft mud has stopped coming in from the small ditches. While the canal can then be cleaned with either a floating dipper or orange-peel-bucket dredge, the best way is by the use of a hydraulic dredge. All overhanging and unstable banks should be sloped by hand in advance of the dredge work; this material then can be taken out along with the soft material in the canal bottom. The chief objection to the use of the hydraulic dredge for this clean-out work is the effect of the water and soft mud on the growing crops along the canal. To avoid this damage a small excavator mounted on skids along the side of the canal has been used very successfully. By keeping the canal practically empty of water, the soft mud will solidify enough to allow it to be taken out by means of either an orange-peel or clam-shell bucket handled by the excavator mounted on the bank. If this cleaning of the canals is done after they have been cut and the land well drained for three or four years, further cleaning will not be necessary for a long term of years. Because of

[1] U. S. Dept. Agr., Department Bulletin 304, contributed by Office of Public Roads and Rural Eng.

the long growing season various kinds of water plants grow in the water and float on the surface. Such plants will have to be removed about twice a year, or they will impede the flow of the water seriously.

The influence of evaporation at different seasons of the year causes a great variation in the manner of operating the pumps. A heavy rainfall in summer necessitates continuous operation of the pumps for a period sufficient to empty the canals and ditches. The water that will continue to run out of the lateral ditches will often be more than balanced by the evaporation, so that it will not be necessary to start the plant again until another period of heavy precipitation occurs. Small local rains in summer in all likelihood will pass unnoticed. During the winter months a heavy precipitation necessitates a relatively longer period of pumping than in summer. Two or three days after the canals have been emptied the ground-water drainage entering through the lateral ditches will make it necessary, owing to lack of evaporation, to operate the plant for a few hours, and after an interval of about 10 days it will be necessary to do some more pumping, although no precipitation may have occurred in the intervening period. If the reservoir capacity of the canals be small, the operation of the pumping plant will be still more intermittent. If the plant be divided into two or more units, one unit only may be operated for the dry-weather run-off. The total time of pump operation during the year rarely exceeds 45 days of 24 hours each, and often drops to as low as 15 days. The total number of days on which the pumps are operated averages about 70.

In southern Louisiana most of the pumping plants so far installed have a theoretical capacity of at least 1 inch, and many of them 1½ inches, in depth of water over the inclosed area in 24 hours. The 1-inch run-off is equivalent to approximately 27 second-feet per square mile of area, or 0.042 second-foot per acre.

The necessary capacity of a pumping plant depends on the size and slope of the district to be drained, the depth and nature of the muck, the available storage capacity of canals and ditches, the system of lateral drains used, the method of operation of the plant, the character of the crops raised, and the amount and distribution of the rainfall. The proper allowance to be made for each of these factors can be determined only as the result of careful and complete observations in the field. Not only should the results for each district examined be worked out carefully, but the investigations should include a sufficiently large number of typical districts and should continue for such a length of time as to make the results of general application. Some of the above factors have been quite closely investigated over a few districts, and all of them have been covered in a general way. While the results obtained are not final, and the investigations still are being carried on, these details will be discussed in the light of such investigations as have been made.

In planning gravity drainage districts it is customary gradually to decrease the run-off coefficient as the size of the district increases. With one exception the variation in size of the district in this section is as yet not great; therefore not much attention need be given this feature. In the summer, when rains are almost purely local, the larger district is not so likely to receive rains over its whole surface as is the smaller. However, the rains that tax the pumping plant most heavily occur in the spring of the year and are general in character.

The variation in surface elevation on the average district is slight, but where the district fronts on a ridge having an elevation above the prairie land of from 8 to 12 feet it has been noticed that the lower lands become flooded at times of heavy rainfall, even though the pumping plant capacity on the district in question be larger than that sufficient for the flat lands. This flooding of the lower

lands can be partly overcome by a proper design of the various parts of the collecting system. By careful location of gravity outlet ditches this drainage water from the higher lands can be entirely diverted in some cases.

The character and depth of the layer of muck overlying the subsoil on these lands have a large influence on the run-off. The muck absorbs water very readily, and if well drained to a depth of 3 feet its storage capacity is about 8 inches. When the land is first drained this muck will absorb water nearly as fast as the heaviest rate of precipitation, but as it decays and compacts both the storage capacity and the rate of absorption decrease very rapidly. A gradual increase in the rate of run-off then must be expected.

The effect of reservoir capacity has already been discussed. However, it might be well to point out that increase of reservoir capacity does not decrease the amount of pumping to be done, but simply acts to decrease the time of flooding in case the run-off overtaxes the capacity of the plant.

Deep lateral drainage acts to decrease the intensity of run-off. If such laterals be lines of tile, the rate of run-off will be decreased still further, for practically all water must then pass downward through the soil and out through the tile before it can reach the canal, while in the case of open field ditches most of the water can flow over the surface to the ditch and thus directly into the canal. Especially will this effect be noticed as the muck gradually loses its power of rapid absorption.

If the pumping plant be designed to operate continuously, its capacity may be less than that of a plant intended for day use only. As mentioned previously, there is need of the plant at all times of the year. The fact that the water is always pumped out promptly and all reservoir capacity is quickly available makes a smaller plant capacity practicable.

While a knowledge of the total yearly and monthly amounts of rainfall, either maximum or average, is important in determining the probable total amount of water to be pumped each year or month, the intensity of rainfall during storm periods extending over only a few days is the factor that fixes the necessary capacity. As the run-off from a given rainfall will depend largely on the condition of the soil before the rain occurred, a determination has been made of the proportion of storms that occur when the land is wet, by examining the records of rainfall and pumping kept since June, 1909, on a number of typical districts in southern Louisiana. Of all the storms exceeding 2 inches and under 4, in 24 hours, 64 per cent occurred on a wet and 36 per cent on a dry surface; for the storms exceeding 4 inches in 24 hours the percentages are 54 and 46 per cent, respectively. Of course, the storage capacity of the land influences the rate of run-off from the small storms relatively much more than it does that of the large ones. However, an examination of the daily rainfall and pumping records shows that the heavy rains on a dry soil do not make a very heavy demand on the pumping plant. It is believed that on this account a reduction of about 30 per cent in the average frequency of storms as tabulated on page — could safely be made and that the resulting figure would be the proper one to use when estimating how often a storm would occur on a wet soil.[1]

Knowing the character of the operations to be conducted on the land of a given district, a decision can then be reached as to the heaviest storm for which provision must be made. On a district where staple crops are to be raised it would be a matter of economy to allow a certain amount of flooding oftener than would be permissible on land where high-priced truck crops are to be raised, while in residence districts it would be desirable to prevent all sur-

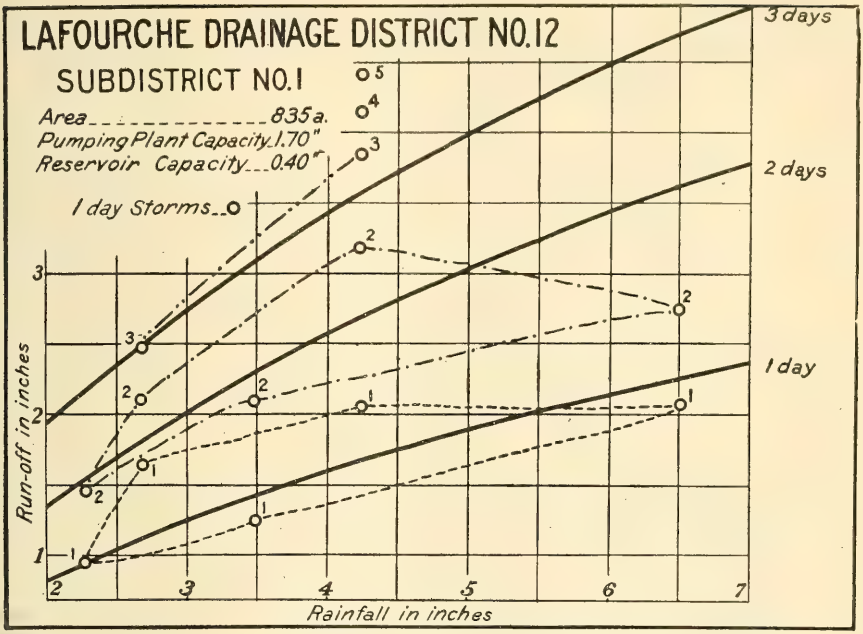
[1] For a full discussion of the relation between rainfall and run-off in southern Louisiana, see Journal of Agricultural Research, Vol. XI, No. 6, Nov. 5, 1917.

face flooding. In addition to the damage to crops due to flooding there are other factors to be considered, such as inconvenience to residents and the possible depressing influence on land values of floodings occurring even at infrequent intervals.

A study has been made of the results of all such heavy storms as occurred on the districts where records have been kept. For almost the entire period covered by the record at each pumping plant, hourly readings have been made of the stage of water in the main reservoir canals during the operation of the pumps. Also, the amounts of water stored in the main reservoir canals at the different levels have been calculated. By this means the amounts pumped per day during the heavy storms have been so adjusted for a number of typical storms on each district, that the final results represent approximately the quantity of water that would have been removed had the pumps taken the water as fast as it entered the main reservoir canals; in other words, these results represent approximately the true run-off for the storms selected. With the exception of a very few heavy storms, only such were selected as occurred when the land in the district was saturated, or at least fairly wet. Owing to the differences in the degree of wetness of the land, the intensity of the rainfall, the time of the year, the condition of the drainage channels, etc., the results for a given district are not uniform. However, to aid in judging what run-off would occur under average conditions the results are shown in the form of curves (figs. 11 to 15). The amounts of run-off, in inches of depth, for one, two, three, and four day periods have been plotted as ordinates and the rainfall, in inches, for each storm as abscissas. Dotted lines have been drawn through the points representing the run-off for each period. The curves have been drawn as far as possible to average these groups of points, or zones, and to conform to each other at the same time. On each set of curves is shown the area of the district, the average capacity of the pumping plant per 24 hours (this will be somewhat different from that shown in Table II as the latter is the maximum capacity), and the storage capacity of the main drainage channels between the surface and a level 5 feet below. In the case of the New Orleans Land Co. tract the water discharges by gravity as fast as it enters the main outfall canal, so no figures for pumping plant and reservoir capacity are given.

It is evident that the effect on the run-off of a change in the capacity of the pumping plant can not all be accounted for by the change of level of the water in the main reservoir canals, as a greater slope and velocity if the water obtains in the drainage channels when a larger plant is operating. This condition is illustrated in the curves, where in general a higher rate of run-off per acre is shown on districts having the larger pumping plants. The effect extends to the small field ditches which have considerable storage capacity, the amount of which it is not practicable to estimate.

In using these curves to estimate the run-off likely to be caused by an assumed storm on an assumed district, the curve should be selected for the district which resembles the assumed district in area, pumping, and reservoir capacities, and other general conditions. The curves of course must be considered merely as representing general tendencies rather than definite values. However, by their use it should be possible to approximate the relative and combined capacities of pumping plant and reservoir canals necessary to remove the run-off caused by a given rainfall. For example, suppose it is desired to determine the required reservoir capacity for a district resembling in a general way the Smithport Planting Co. tract, where the capacity of the pumping plant is to be 1 inch. For a storm of 5 inches in 24 hours the curve for the Smithport Planting Co. tract shows that 0.4 inch would be left as surplus in the reservoir



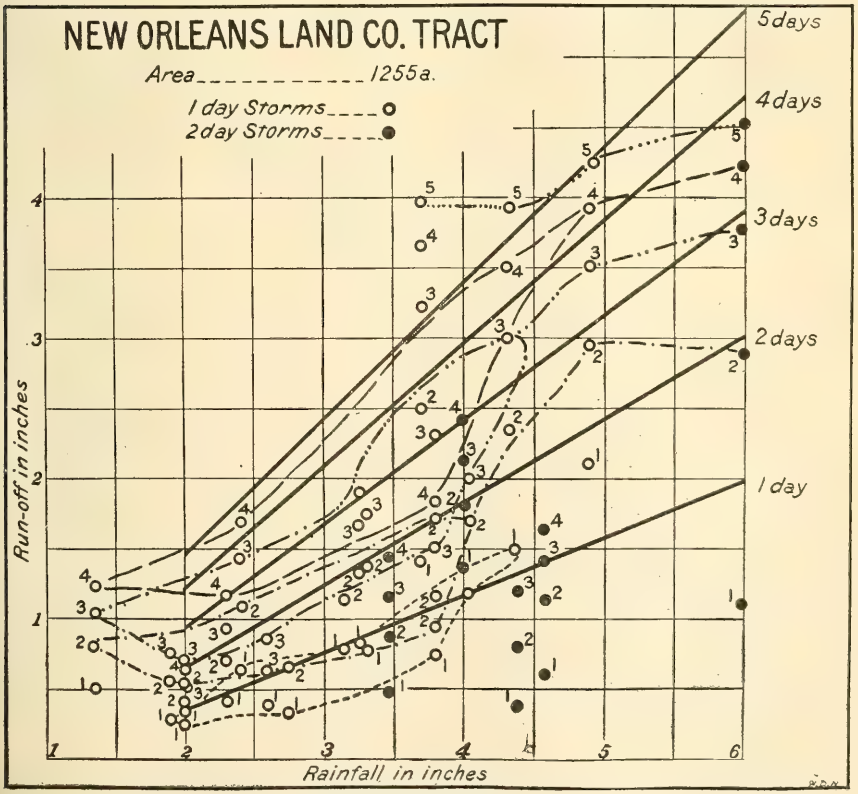
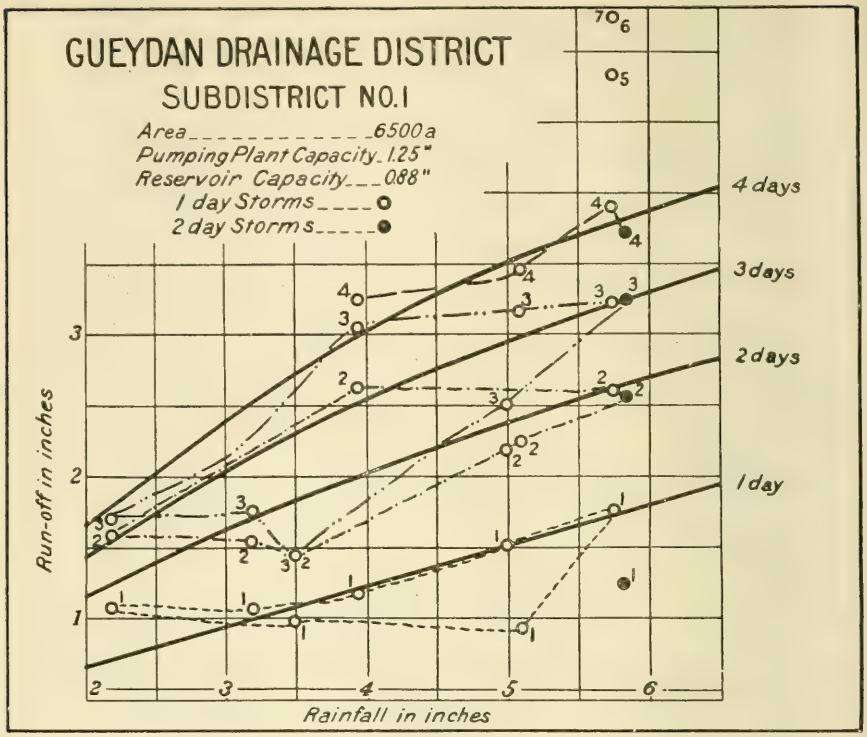


FIG. 11.—Probable actual run-off from drainage districts in southern Louisiana.



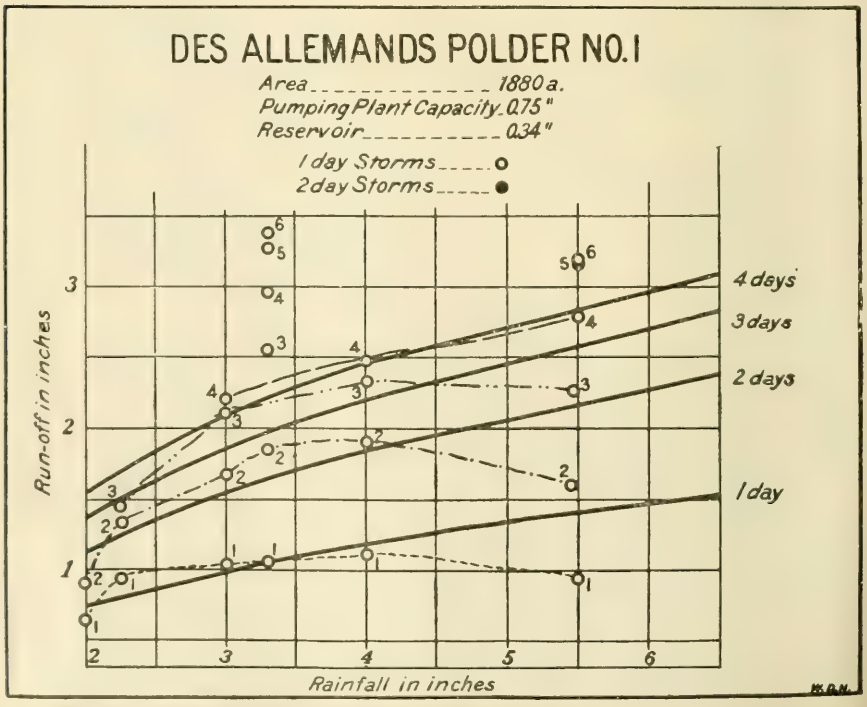
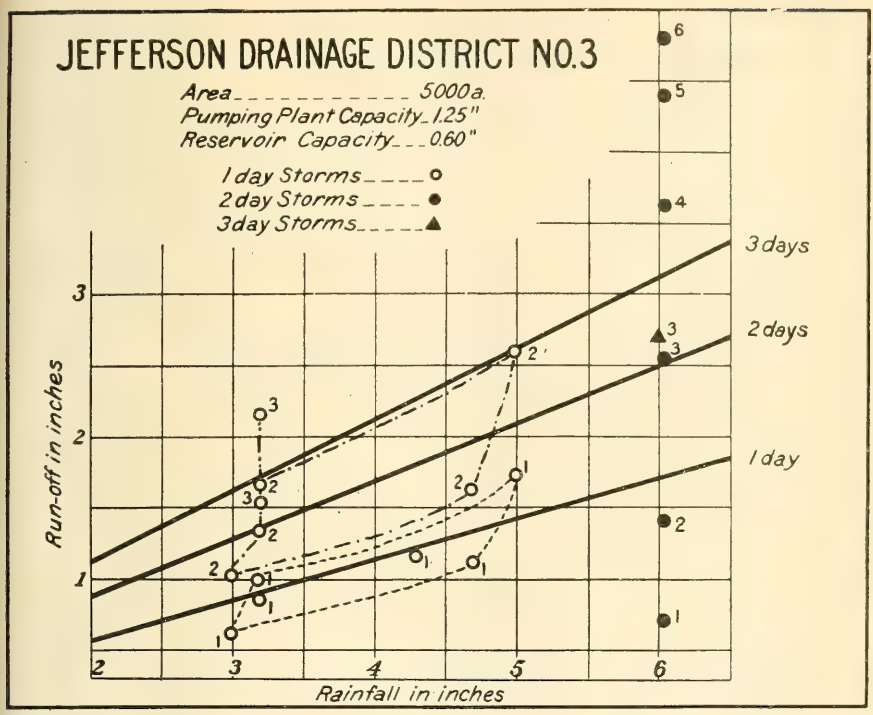


FIG. 12.—Probable actual run-off from drainage districts in southern Louisiana.



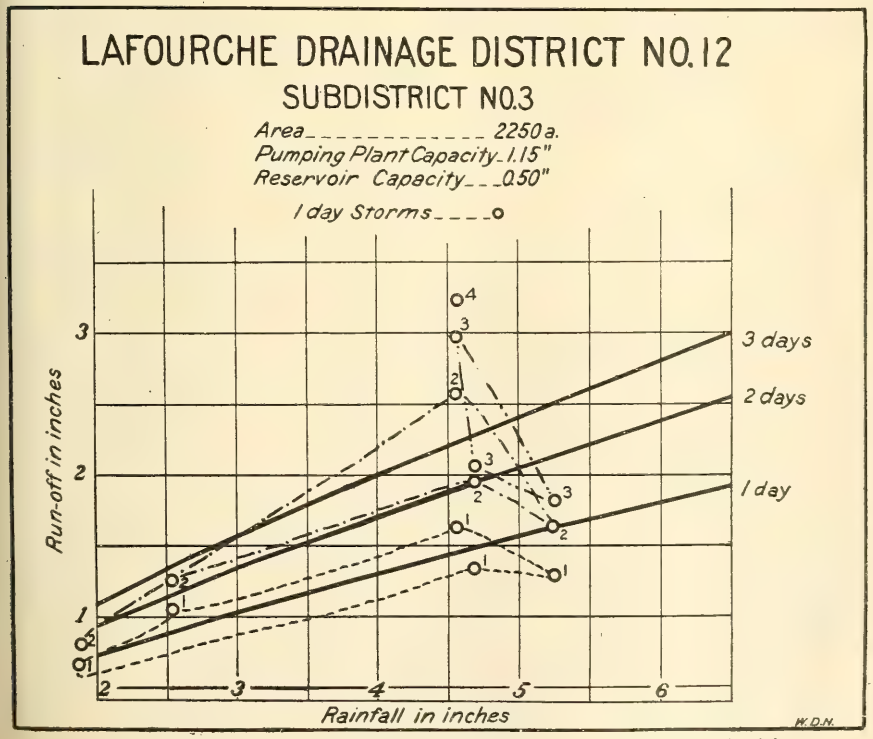
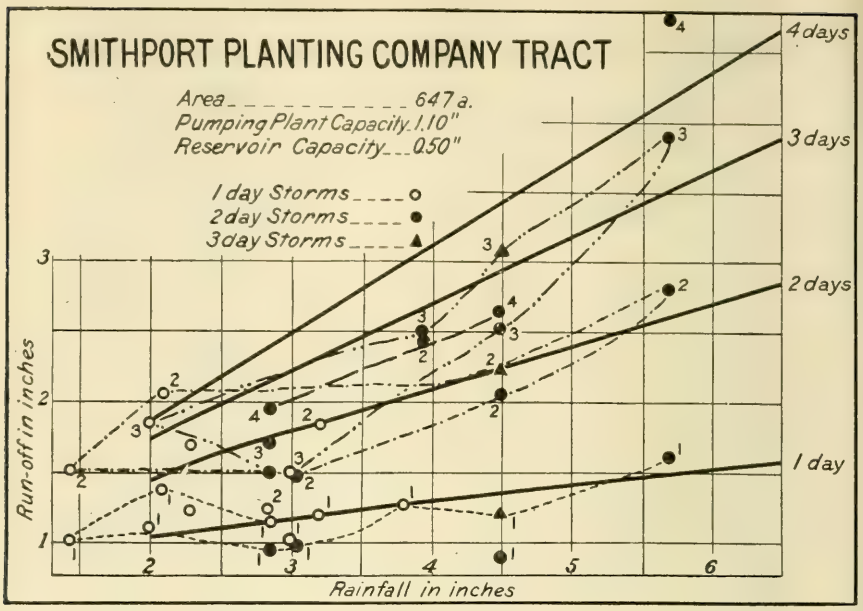


FIG. 13.—Probable actual run-off from drainage districts in southern Louisiana.



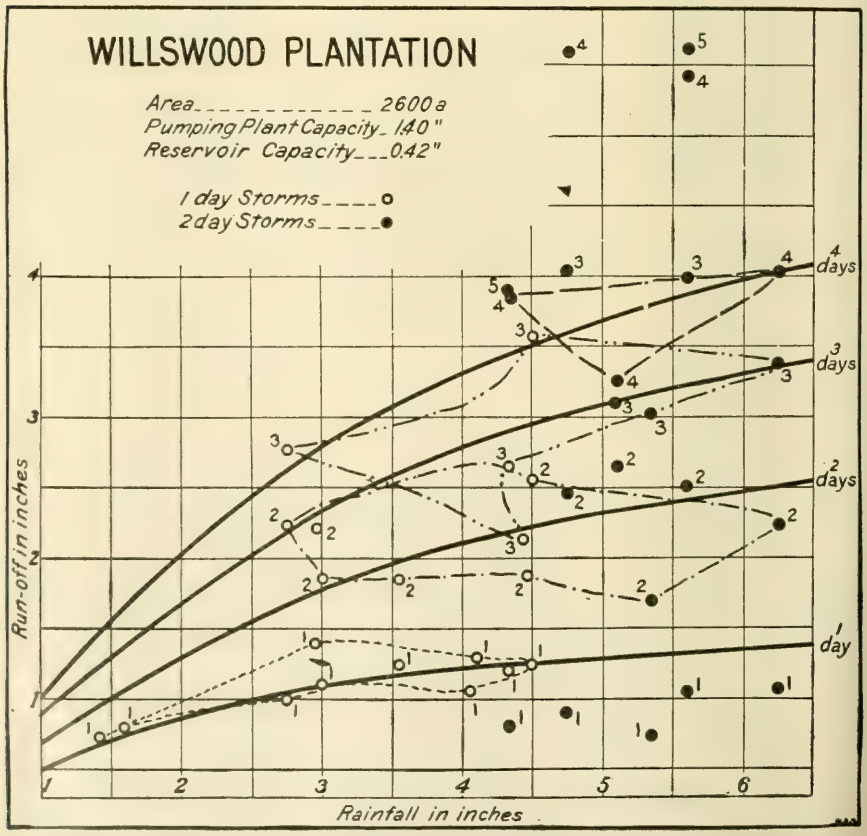


FIG. 14.—Probable actual run-off from drainage districts in southern Louisiana.

canals at the end of the first 24 hours. At the end of the second 24 hours the surplus still would be 0.4 inch, while at the end of the third day it would have been reduced to 0.2 inch. Before the end of the fourth day the pumping plant would have lowered the water to a level 5 feet below the surface of the land. Since the greatest amount of surplus water left in the reservoir at any time was 0.4 inch, a reservoir having this capacity would be able to prevent flooding, provided the run-off was as shown on the Smithport curves. By making other assumptions as to capacity of plant, the corresponding capacity of reservoir can be approximated. Then by calculating the cost of each pumping plant and each reservoir, using current prices for material and earthwork, the cheapest combination can be determined.

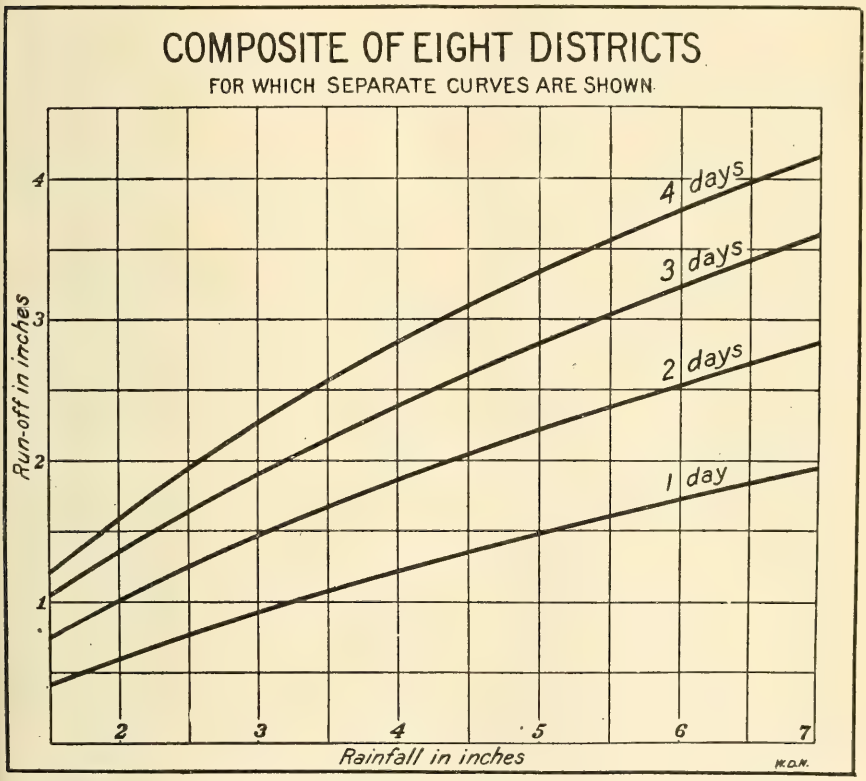


FIG. 15.—Probable actual run-off from drainage districts in southern Louisiana.

In general, a system of reservoir canals having the proper depth and width to give good drainage to the entire area, and allowing the use of average-sized dredges to construct them, will have a reservoir capacity of about 0.5 inch in depth over the entire tract. This size will be ample to bring the water to the pumping plant fast enough to secure continuous operation until the water is lowered sufficiently in the portion of the canals most remote from the plant. While a further increase in the size of the reservoir will allow a certain reduction in the capacity of the pumping plant, the combined cost will usually be greater with this increase of reservoir. In other words, after a certain point is reached it is cheaper to increase the capacity of the pumping plant than it is to incease the capacity of the reservoir canals.

Although as regards first cost alone it appears that the larger plant and small reservoir should be used, other factors enter into the problem. With larger canals the lift would be less, due to the flatter surface slope of the water flowing to the plant. When pumping from the larger canal the service of the pumping plant would be less intermittent, thus saving considerable of the fuel necessary for firing up the plant. The rate of interest on the cost of the plant would be the same and the expense of clearing the canals of accumulated silt would be more or less independent of the size, at least within reasonable limits. In removing the run-off from a given storm the small plant would have to operate longer, thus increasing the labor charges. The proper weight to give each of these factors would depend on the local conditions in the district in question.

LOCATION, DESIGN, AND CONSTRUCTION OF PLANT.

Theoretically, the plant should be so located that the water in coming to it will travel the minimum length of reservoir canal. This condition will usually be met if the plant is placed in the center of the district and discharges through a leveed outfall canal to some bordering lake or bayou. In practice, however, the plants ordinarily are located on one side of the tract and on some navigable lake or bayou. This greatly facilitates the transportation of heavy machinery during the erection of the plant, as the ground usually is much too soft to allow the hauling of heavy loads. Fuel, also, can then be transported cheaply. If the tract has any considerable slope the logical location of the plant is in the lowest part. However, this part often is very soft, and to secure foundation it may be advisable to locate in some higher and more stable portion. As pointed out in the discussion of levees, there are frequent ridges of silt winding through these swamps, and often a plant can be located on one of these solid ridges. While it would be necessary to use a great many piles under the foundation in either case, the number can be reduced if the plant is located on a ridge.

The foundation under both the machinery and the building of a pumping plant should be of concrete, well supported by piling. A plan of the foundation under the plant at Gueydan already has been shown (fig. 10) and is a good illustration of a foundation in this character of soil. The foundation under the plant on the Des Allemands drainage district, already illustrated (fig. 8), also is a good one. It will be noted on both these plans that the foundation is surrounded by sheet piling and that under the center of the Des Allemands plant a line of sheet piling has been driven and extended into the concrete. In these soft soils such precautions are necessary. The engine and pump are usually mounted on the same block of concrete, so that any subsequent settlement can not throw them out of line.

While buildings to inclose the machinery should be durable and of fireproof construction, they are not called upon to protect the machinery and attendants from low winter temperatures. A frame of structural steel covered with heavy, corrugated, galvanized iron answers the purpose very well, although in one case a brick building has been erected. These buildings should be capable of resisting the action of the tropical hurricanes, for it is at such times that the need for the plant is greatest.

The selection and arrangement of machinery in centrifugal pumping plants have been discussed in detail in publications of the department.[1] While the local conditions considered in those publications are somewhat different from

[1] U. S. Dept. Agri., Dept. Bul. 304, contributed by Office of Public Roads and Rural Eng.; U. S. Dept. Agr., Office of Experiment Stations, Cir. 101.

those in southern Louisiana, the same principles are involved, and the same general features are to be considered.

The average lift of the drainage pumping plants is from 4 to 6 feet, with the total head ranging from 0 to 10 feet. Special attention should be given to the reduction to a minimum of all friction and velocity-head losses, as a poor arrangement of piping to the pumps may easily increase the total head 50 to 75 per cent. Plants have been inspected where the total head on pump was nearly double the useful lift. The cost of properly designed pipes is very little more than that of pipes which cause large losses.

The design of the pumps must be especially suited to low and variable lifts in order to give efficient service. The ordinary centrifugal pump designed for higher lifts is very inefficient when used on low-lift conditions. Sometimes it is advisable to design the pumps to run most efficiently at considerably less than the maximum capacity required of them when the demand is the heaviest. Thus nearly all the water can be pumped while running the pumps at the best possible capacity for efficiency, as the number of days per year that the plant will be called upon to operate at its maximum capacity are very few, averaging perhaps five. In this way a comparatively small and cheap plant can be installed and the maximum required capacity obtained by speeding up the pumps above their normal rate.

Various types of pumps have been examined in the plants inspected. The horizontal centrifugal pump and the horizontal screw pump are the only ones entirely suitable for drainage service of this nature. One large rotary pump was inspected, and while it was pumping water very efficiently, the minimum lift through which it could work was 10 feet, which was nearly twice the required lift. Such pumps are more expensive and require more expensive foundations than do centrifugal pumps.

It is advisable to install not less than two units in a plant. The low stages of water in the reservoir canals can then be handled properly, and a breakage of machinery would not render the plant inoperative. Owing to the fact that the soil on the average reclamation district will subside from 2 to 3 feet during the early years of reclamation, both the average and the maximum lift of the pumping plant will probably increase by that amount. Provision should be made for this increase of lift by having sufficient power for driving the pumps and by having the suction pipe of sufficient length.

On all pumps some means should be installed of indicating whether or not they are discharging at the proper rate under a given set of conditions. Vegetation growing in the reservoir canals will be carried through even a closely spaced screen in the suction basin and will lodge on the impellers; this will reduce the capacity materially even if its presence can not be detected by the most careful operator. Tests have been made on plants where the capacity was reduced as much as 30 per cent from this cause. Where the pump has two suction pipes, vacuum gages installed on the pipes close to the pump will indicate by a sudden change in pressure that débris has become entangled in the impeller. An instrument known as a rate-of-flow meter, reading in thousands of gallons per minute, has been devised for connecting to the discharge pipes; this will indicate at all times the amount of water passing through the pumps. If the amount of water indicated by this meter is less than it should be for a certain lift and speed of rotation of the impeller, the pump should be cleared of débris at once. After pumps are installed a thorough test should be made to see whether or not they come up to the guaranteed efficiency and to determine the proper speed at which to run them to obtain the best efficiency.

All the older pumping plants in this section were driven by steam engines; the types of engine varied from the cheapest slide-valve to the most expensive type

of poppet valve using super-heated steam. Within the last three years a number of internal-combustion engines have been installed. These, too, vary in character from the ordinary gasoline-burning engine to those which burn the heavy crude oils. One plant close to New Orleans uses electric power. Both the internal-combustion engines and the electric motors have great advantages over the steam engines when used on intermittent service. There are considerable losses, both of fuel and labor, in starting a steam plant, while the other types can be started without much loss of either. Although the total period of operation of the average drainage pumping plant is about 20 days of 24 hours each per year, the plant probably will operate on as many as 90 different days. This means that the average period of operation for each time it is fired up will be very short, perhaps less than 6 hours; therefore a large percentage of the fuel burned will be used in getting started. Owing to the familiarity of ordinary workmen with steam engines, and to the simplicity of such engines, they still are very popular as a source of power for driving the pumps. On the other hand, the great saving in labor and fuel obtained by the use of engines burning crude oil has resulted in all the newer plants being driven by oil engines. The depreciation of the steam plant, particularly of the boiler because of bad feed water and the rapid corrosion of sheet metal in this climate, is much greater in such intermittent service than is the depreciation of internal-combustion engines.

Cost of Pumping Plants.

The cost of drainage-pumping plants, per indicated horsepower, varies widely according to type of machinery, expense of transportation of machinery to site of plant, character of foundation, and difficulty of erection. The last three items will vary greatly according to local conditions. An accompanying diagram (fig. 16) shows comparative approximate costs of single-unit centrifugal pumping plants erected complete, inclusive of foundations, but exclusive of buildings, intake, discharge canals, or flume. These costs are based on estimates for work in Louisiana and Texas, and the diagram is published by courtesy of H. L. Hutson, New Orleans, La. These figures are approximate, but are on the safe side; that is, they take into consideration construction under unusual difficulties. In making up these costs it was assumed that the effect of the three items mentioned as varying according to local conditions would be a constant percentage of the cost of the plant. It is obvious that this diagram should not be used in attempting to determine accurately the cost of a drainage plant; its chief usefulness is in showing the relative cost of the various types of machinery, for deciding upon the most economical size of unit to be used in large plants, and for making approximate estimates of the total cost of plants.

In making the diagram, the cost of the plant has been divided into the cost of the "water end" (pump, pump foundation, and piping), and the cost of the "steam end" (engines, boilers, and their foundations and auxiliaries). The cost of the water end is given in terms of gallons per minute of rated capacity, and that of the steam end in terms of indicated horsepower. Owing to the variation in costs it is necessary to use zones instead of lines to indicate them.

The zone marked "steam end, compound condensing Corliss or 4-valve engine" includes the cost of this type of engine and water-tube boilers. The zone marked "Compound condensing slide valve" includes the cost of this type of engine and either water tube or return tubular boilers, according to the size of the plant. The zone marked "Simple slide-valve noncondensing" includes the cost of this type of engine and horizontal return tubular boilers. It will be noted that for the higher class engines the cost is not indicated below about

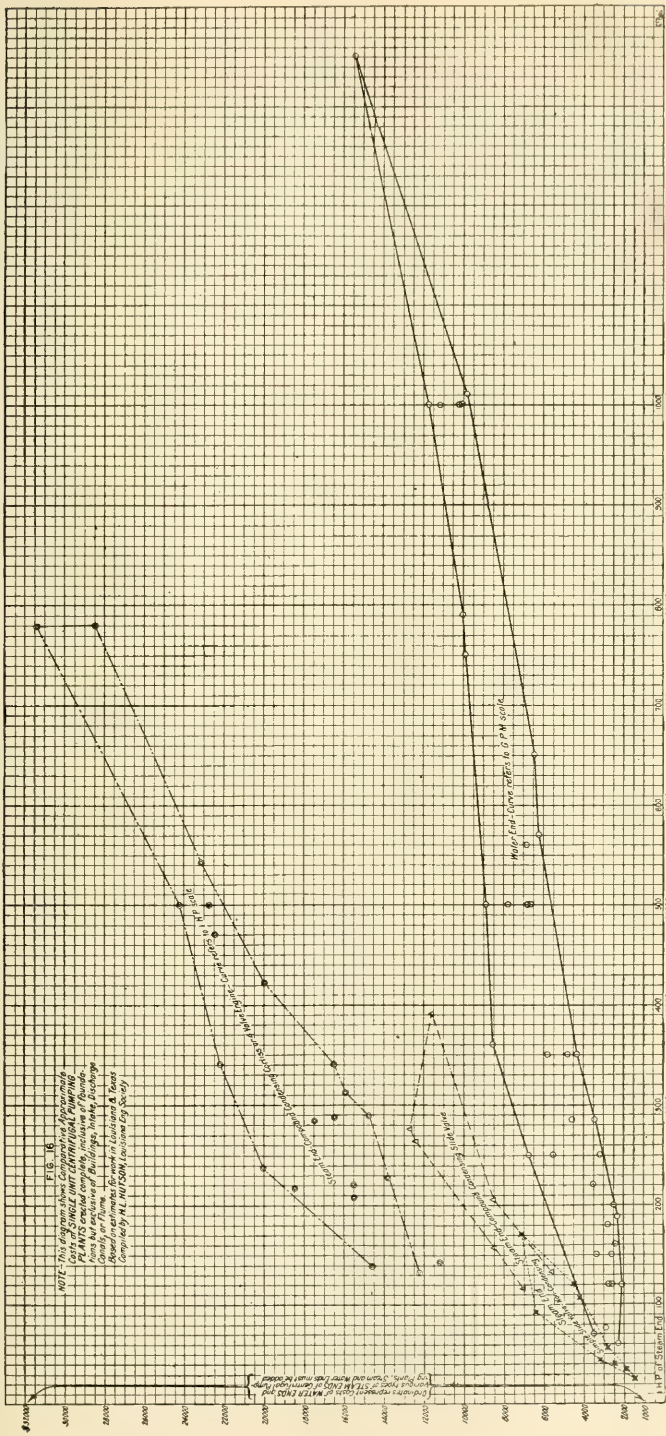


FIG. 16.—Data from plants constructed prior to 1914.

100 horsepower, as engines of this class can not be purchased in smaller sizes than 75 or 100 horsepower.

In estimating the cost of a plant the following steps are necessary. With a given capacity of plant in gallons per minute, estimate the cost of the water end by use of the water-end zone. In order to get the cost of the steam end the indicated horsepower must be calculated first. First the water horsepower is determined, knowing the capacity and lift of the plant; then this is divided by the combined efficiency of the engine, transmission, pump, and piping, which will give the indicated horsepower. By using the various zones of cost of different types of engines, the cost of the steam end can be determined. Then by combining the cost of water end and steam end the total cost of plant will be determined.

TABLE II.—*Descriptions of equipment and unit prices of operating expense.*

District	Location.	Pumps.				Excess lift (actual exceeds effective).	Transmission of power.	Engines.	
		Number and kind.	Size.	Capacity.				Number and kind.	Size.
				Per second.	Per 24 hours.				
				Cu. ft.	*Inches.*	*Feet.*			
Smithport Plantation	Lockport [1]	1 square wooden-case centrifugal.	32 by 12 inch impeller.	30	1.10	2.0	Rope drive	1 slide-valve non-condensing.	11 by 12 inches.
		do	24 by 8 inch impeller				do	do	12 by 10 inches.
Willswood Plantation	Waggaman	1 square wooden-case centrifugal.	42 by 16 inch impeller.	153	1.40	5.0	Rope and bevel gear.	2 slide-valve non-condensing.	16 by 24 inches.
		1 rotary	7 feet wide			5.0	Rope drive	Automatic	16 by 24 inches.
Reclamation district No. 1	Poydras	1 horizontal cast-iron centrifugal.	36-inch discharge			2.0	Direct connected	1 double slide-valve vertical.	14 by 14 inches.
		1 horizontal cast-iron centrifugal.	do	100	.95	[2] 2.5	do	1 slide-valve non-condensing.	14 by 18 inches.
		do	24-inch discharge			[3] .6	do	do	10 by 14 inches.
Lafourche drainage district No. 6, subdistrict No. 1.	Des Allemands	2 horizontal cast-iron centrifugal.	do	59	.75	.3	do	2 slide-valve vertical.	12 by 12 inches.
Lafourche drainage district No. 12, subdistrict No. 3.	Raceland	do	30-inch discharge	109	1.15	.75	do	do	14 by 16 inches.
Gueydan drainage district, subdistricts Nos. 1 and 2.	Gueydan	do	54-inch discharge	394	1.25	.3	do	2 Corliss noncondensing.	16 by 36 inches.
New Orleans Lake Shore Land Co.	Ponchartrain Groves.	do	48-inch discharge	350		.6	Herringbone gear.	Electric motors	2 215-horsepower.
Jefferson drainage district No. 3	Lafitte	do	do	263	1.25	.4	Direct connected	2 Corliss noncondensing.	16 by 36 inches.
Lafourche drainage district No. 12, subdistrict No. 1.	Raceland	do	24-inch discharge	60	1.70	.4	do	2 40-horsepower oil-burning.	14½ by 21 inches.

[1] Large plant, on account of leaking levees.

[2] March, 1912, to August, 1913.

[3] Since August, 1913.

TABLE II.—*Descriptions of equipment and unit prices of operating expense.*—Continued.

District.	Location.	Efficiency of engine, pump, and piping at average effective lift.	Boilers.		Fuel.		Labor.		General condition of plant.
			Number and kind.	Size. (horsepower).	Kind.	Unit cost.	Wages.	Grade.	
		Per cent.							
Smithport Plantation	Lockport [1]	Not tested Low	1 return, tubular	100	Coal and oil [2]	$4 per ton; $1.15 per 42 gal.	$1.50 per day of operation.	Unskilled	Poor.
Willswood Plantation	Waggaman	12	2 water-tube	150 each	Oil	$0.80 to $1.70 per bbl. [3]	$3 per day of operation.	Good	Good.
		32	1 return, tubular.	80	do		$1.50 per day	Unskilled assistant.	
Reclamation district No. 1	Poydras	53	2 return, tubular.	80 each	Oil and coal	$0.90 per bbl	$1.80 per day	Good engineer	Do.
					Coal	$3.25 per ton	$1 per day	Fair fireman	
Lafourche drainage district No. 6, subdistrict No. 1.	Des Allemands	55	2 return, tubular.	60 each	Oil	$1.15 per bbl	$1.50 per day of operation.	Good	Do.
Lafourche drainage district No. 12, subdistrict No. 3.	Raceland	35	do	100 each	do	do	do	Unskilled	Fair.
Gueydan drainage district, subdistricts Nos. 1 and 2.	Gueydan	55	do	150 each	do	$0.80 to $1.25 per bbl.	$100 per month, 1912; $3 per day.[4]	Expert engineer.	Good.
							$1.50 per day	Good fireman	
New Orleans Lake Shore Land Co.	Ponchartrain Groves.	50				(5)	do	Good	Do.
Jefferson drainage district No. 3	Lafitte	55	2 return, tubular.	150 each	Oil	$1.15 per bbl	$35 per month	Expert	Do.
Lafourche drainage district No. 12, subdistrict No. 1.	Raceland	40			do	$1.50 per bbl	$1.50 per day	Fair	Do.

[1] Large plant, on account of leaking levee.
[2] Fuel changed from coal to oil, September, 1912.
[3] In 1912, cost of fuel oil rose from $0.80 to $1.70 per barrel.
[4] About January, 1913, the engineer was changed from a monthly wage to a rate per day when operating plant.
[5] 1 cent per kilowatt hour plus $230 per month fixed charge.

TABLE III.—*Costs and conditions of operation.*

District.	Area.	Year.	Rainfall.	Run-off.	Average effective lift.	A.F.F.[1]	Cost. Fuel.	Cost. Labor.	Cost. Repairs and incidentals.	Cost. Total.	Cost. Per acre.	Per A. F. F.[1] Total.	Per A. F. F.[1] Fuel.	Number of days on which plant operated.	Number of times boilers were fired up.	Number of 24-hour days per year at full capacity.	Hours at full capacity per fire-up.	Longest period of continuous operation.	Number of times plant was run continuously more than following number of days. 1	2	3	4	6	10
	Acres.		*Inches.*	*Inches.*	*Feet.*													*Days.*						
Smithport Plantation	647	[2] 1911	57.52	33.35	5.2	9,400	$667	$351	$150	$1,168	$1.80	$0.125	$0.071	115	103	33.0	7.7	2.0	8	1	0	0	0	0
	647	[3] 1912	52.23	40.80	5.5	12,190	795	342	170	1,307	2.02	.108	.066	108	77	49.5	12.9	4.3	12	5	3	1	0	0
	647	1913	60.01	37.77	5.8	11,840	780	215	35	1,030	1.60	.087	.066	86	68	34.2	12.0	3.8	10	3	1	0	0	0
Willswood Plantation.	2,400	[4] 1909	43.32	16.33	5.0	16,330	936	600	230	1,766	.73	.108	.057	45	39	20.0	7.3	2.5	3	1	0	0	0	0
	2,400	1910	43.08	11.58	5.0	11,580	616	500	180	1,296	.54	.112	.053	45	41	8.4	4.9	.75	0	0	0	0	0	0
	2,600	1911	52.32	23.42	5.0	25,290	1,267	753	300	2,320	.89	.092	.050	69	61	19.2	7.6	3.5	5	1	1	0	0	0
	2,600	[5] 1912	48.22	34.42	5.0	37,290	2,676	765	514	3,955	1.52	.106	.072	81	63	35.0	8.9	4.0	10	4	1	1	0	0
	2,600	1913	51.52	27.08	5.0	30,180	2,412	848	457	3,717	1.43	.123	.080	68	60	17.5	7.0	2.0	6	2	0	0	0	0
	2,600	1914	42.25	15.05	5.0	16,320	1,210	426	464	2,100	.81	.129	.074	41	39	9.7	6.0	2.2	2	1	0	0	0	0
	2,600	1915	5.05	34.24	5.0	37,100	3,030	751	922	4,703	1.80	.127	.082	63	49	24.5	12.0	4.77	8	3	3	2	0	0
Reclamation district No. 1 Poydras.	2,500	[6] 1912	70.52	28.28	2.1	12,420	1,098	640	244	1,982	.79	.160	.088	114	77	41.8	10.5	14.0	12	9	7	4	1	1
	2,500	1913	63.45	38.82	4.5	36,580	2,314	1,261	347	3,922	1.57	.107	.063	155	131	46.5	8.5	6.5	4	3	2	1	1	0
	2,500	1914	47.70	16.46	5.2	18,320	743	764	408	1,915	.77	.105	.041	73	71	17.8	6.0	2.0	2	1	0	0	0	0
	2,500	[7] 1915	36.14	16.21	5.2	17,572	755	582	180	1,517	.61	.086	.043	62	60	22.8	6.8	1.77	5	0	0	0	0	0
Lafourche drainage district No. 6, subdistrict No. 1.	1,880	1913	47.37	31.00	5.1	24,910	1,526	564	116	2,206	1.18	.089	.061	210	198	40.0	4.8	5.0	5	4	2	1	0	0
	1,880	1914	45.70	25.83	5.3	21,340	871	517	65	1,453	.77	.068	.041	178	159	35.3	5.3	4.8	8	5	2	1	0	0
	1,880	[7] 1915	28.41	21.94	5.4	18,745	1,160	331	25	1,516	.80	.081	.062	92	75	39.0	9.4	3.71	11	7	3	0	0	0
Lafourche drainage district No. 12, subdistrict No. 3.	2,250	1913	52.04	20.84	2.9	11,270	930	306	331	1,567	.70	.140	.082	90	90	15.5	4.1	.75	0	0	0	0	0	0
	2,250	1914	58.95	23.40	3.5	14,870	1,140	233	194	1,567	.70	.106	.077	78	71	18.7	6.3	1.60	3	0	0	0	0	0
	2,250	[7] 1915	33.07	11.61	4.2	9,087	1,115	112	265	1,492	.66	.164	.123	41	39	13.5	6.2	1.42	2	0	0	0	0	0

[1] Acre-feet of water lifted 1 foot.
[2] March, 1911, to February, 1912, inclusive.
[3] March to December, inclusive.
[4] June to December, inclusive.
[5] January to May and October to December, inclusive
[6] March 9 to December 31.
[7] January to September, inclusive.

TABLE III.—*Costs and conditions of operation*—Continued.

District.	Area.	Year.	Rainfall.	Runoff.	Average effective lift.	A. F. F.[1]	Cost. Fuel.	Cost. Labor.	Cost. Repairs and incidentals.	Cost. Total.	Cost. Per acre.	Cost. Per A. F. F. Total.	Cost. Per A. F. F. Fuel.	Number of days on which plant operated.	Number of times boilers were fired up.	Number of 24-hour days per year at full capacity.	Hours at full capacity per fire-up.	Longest period of continuous operation.	Number of times plant was run continuously more than following number of days. 1	2	3	4	6	10
	Acres.		*Inches.*	*Inches.*	*Feet.*													*Days.*						
Gueydon drainage district, subdistricts Nos. 1 and 2.	6,500	[2] 1912	41.71	37.26	3.6	75,200	$2,640	$1,225	$795	$4,660	$.72	$.062	$.035	196	185	40.0	4.1	4.0	6	3	2	1	0	0
	7,500	[3] 1913	77.61	65.86	5.0	194,000	6,013	1,321	631	7,965	1.06	.041	.031	214	173	53.0	7.4	19.54	13	5	2	1	1	1
	6,500	[4] 1914	59.78	39.86	5.1	109,350	.....	.....	.....	5,175	.79	.047	.....	166	162	28.0	4.1	5.2	7	1	1	1	0	0
	6,500	[4] 1915	49.77	24.21	5.2	68,644	1,833	1,180	867	3,880	.60	.056	.027	78	77	19.4	6.0	2.79	6	2	0	0	0	0
New Orleans Lake Shore Land Co.	6,040	[5] 1914	50.60	20.46	4.5	46,760	[6]3,932	.....	.....	5,650	.....	.121	.084	308	308	16.0	1.2	.6	0	0	0	0	0	0
	6,943	[7] 1915	36.80	20.33	5.2	61,496	[6]3,603	912	34	4,549	.65	.074	.059	172	.....	21.7	.....	2.15	3	2	0	0	0	0
Jefferson drainage district No. 3.	5,000	[8] 1913	49.60	28.42	5.1	59,970	2,565	692	480	3,737	.75	.062	.043	121	119	29.0	4.9	2.5	1	1	0	0	0	0
	5,000	[9] 1914	48.16	26.45	4.7	51,630	2,274	595	261	3,130	.63	.061	.044	104	97	18.3	4.5	2.9	5	1	0	0	0	0
	5,000	[7] 1915	44.61	18.18	5.1	38,578	1,600	700	350	2,650	.53	.069	.042	61	59	15.9	5.9	1.83	1	0	0	0	0	0
Lafourche drainage district No. 12, subdistrict No. 1.	835	[8] 1915	30.38	20.25	3.6	5,157	75	160	25	260	.31	.050	.014	41	40	15.9	9.0	1.0	1	0	0	0	0	0

[1] Acre-feet of water lifted 1 foot.
[2] March 17 to December 31. Area 5,600 to Aug. 23, 1912, then increased to 6,500.
[3] Area increased to 7,500 in July; decreased to 6,500 Dec. 31, 1913.
[4] Area 6,500 acres Dec. 1, 1915; 7,500 acres after Dec. 1, 1915.
[5] Average for year, electric plant.
[6] Electric power.
[7] February to December, inclusive.
[8] March 12 to December 31.
[9] January to September, inclusive.

Cost of Operation.

Records of operation have been kept for a number of pumping plants in drainage service in southern Louisiana. Not all of the plants included in these records are typical, neither have conditions been typical, but it is believed that it will be of service to include all the plants so that a comparison may be made of the saving in cost of operation that may be effected, first, by having good levees around the district; second, by properly installing efficient and suitable machinery; third, by operating the plant carefully.

The equipment of each pumping plant, as well as the kinds and costs of fuel and labor, are shown in Table II. Table III shows the costs of operation, including fuel, labor, and repairs; it also shows the conditions under which the plants were operated. For the purpose of comparing the costs for the various plants a unit has been chosen which eliminates any effect of differences in the amounts of water pumped and lifts of the pumps; this unit is the cost of lifting 1 acre-foot of water 1 foot. Of course the pumps with the higher average lifts worked at a relatively greater efficiency. It should be noted that Table III shows average effective lift rather than the actual lift, the former being the difference between the elevation of the water surface from which water is being pumped and that of the water surface where the pumps discharge. The cost of pumping likewise is expressed in the cost of lifting 1 acre-foot of water 1 effective foot.

As an example of the large amount of pumping that may be caused by seepage through poorly designed or built levees, the results for 1912 and 1913 on the Smithport tract and those for 1913 for the Gueydan district should be compared with the results for 1913 and 1914 from subdistrict No. 3 at Raceland. The amount of water pumped on the latter district was scarcely half that pumped on the other two districts, although the amount of rainfall was not far different.

The cost figures given in the table must be compared with due regard to conditions of operation and to the average lift of the pumps. The effect of a change of lift of a pump is shown in the figures for nearly all the plants, but especially in those for reclamation district No. 1 at Poydras, subdistrict No. 1 at Des Allemands, and subdistrict No. 3 at Raceland. On certain other of the plants the fact that an increase in lift has not caused a decrease in unit cost is due to the increase in fuel cost.

As all of the Corliss engine plants are on large districts, a condition that tends to a relatively large reduction in the labor charge per unit of water lifted out of the district, it will be advisable to disregard the item of labor and make the comparison on cost of fuel alone; this will largely eliminate the effect of the size of the district. With the exception of the year 1914, the cost in fuel of lifting an acre-foot of water 1 foot was much less for the Corliss engine plants than for those using slide-valve engines. The plants in subdistrict No. 1 at Gueydan and Jefferson drainage district No. 3 are similar in equipment, except that the pumps in the Gueydan district are larger. It will be noted that the cost of fuel used per unit of water lifted (Table III) is less for the Gueydan district than for the other. The lifts and the lengths of run per fire up are about the same, while the unit cost of fuel (Table II) is lower for the Jefferson plant. This difference in cost of operation might be due partly to the fact that these two plants have the same sized engines, which results in the engines in the Gueydan plant working at about their proper capacity, while those in the Jefferson plant are working at a considerable underload. No doubt, however, the greater part of the difference is in the care with which the oil has been fired under the boilers.

For the plants having slide-valve engines, a comparison of the costs of fuel for lifting an acre-foot of water 1 foot will show that the effect of the highest average lift and the longest run per fire up for the year 1913, which occurred in the Smithport plant, has served to make the latter plant compare favorably with the other slide-valve plants, although it is by far the poorest plant of the lot. On the other hand, the effect of the lowest lift and the shortest run per fire up for the year 1913, which occurred in the Raceland plant, has served to make it the most expensive plant per acre-foot of water lifted 1 foot, although the Raceland plant is the equal of any of the other slide-valve plants. The efficiency of the pumps in the plant at Poydras was increased considerably by the changes made in pipes and impellers in 1913.

The only plant operated by electricity shows a considerably higher cost for power in 1914 for lifting an acre-foot of water 1 foot than do most of the steam plants. However, it will be noted that the amount of pumping was small, and as the relatively large monthly charge for current is a constant, whether the pumps are operated or not, on years of small pumping the unit cost in this plant will be high. In the first nine months of 1915 about the same quantity of water was pumped as in the whole of 1914, but the fixed charge was proportionately less. Therefore the unit cost was much less in 1915 than in 1914.

While a number of plants were in operation in which the pumps were driven by oil-burning engines, the cost data are available only for subdistrict No. 1, Raceland. However, the small unit cost for lifting an acre-foot of water 1 foot is a striking feature of this plant. The unit cost for labor is high on account of the small area of this district. The total charge for labor on a plant of this kind need not be much more for a plant large enough to drain an area several times greater.

The amounts of rainfall and run-off on the districts given in the foregoing tables are not all typical, and an average of them would not give a figure suitable for general application. From these a selection has been made of the typical figures; an average of them is as follows: Rainfall, 48.61 inches; run-off, 21.56 inches; per cent of rainfall appearing as run-off, 44.4. The mean annual rainfall for this section is about 56 inches, so that the amount pumped under average conditions would be a depth of 24.8 inches per year. The average lift for plants in this section would not be far from 5 feet. Following are the average results from the various plants under actual conditions of operation; it includes only those figures which are known to be typical:

Average results from various plants.

Kind of plant.	Total cost of operation per acre-foot foot.	Cost of fuel per acre-foot foot.	Total cost of lifting 2 acre-feet 5 feet.
Steam slide-valve engine	$0.075	$0.050	$0.75
Steam Corliss-valve engine	.060	.035	.60
Oil engine	.040	.015	.40
Electric motor	.097	[1].072	.97

[1] Cost of power.

Since the average amount of water to be removed from drainage districts in this section is about 24 inches per year, the average cost, per acre per year, of operation of drainage pumping plants will be about as shown in the last column of the above table.

Not all the pumping plants have kept careful and complete records of their operation. Without such records it is impossible to know whether or not the plant is being run economically or to ascertain sources of waste. From the standpoint of the owners of the land such records are as essential as are the accounts of any business concern to its proprietors. These records are essential also to progress in the matter of design and construction, not only of the pumping plant, but of the other drainage improvements. If the canal system is adequate or the levee system subject to seepage, careful records of operation will show that further improvement is necessary. The proof of the value of any set of improvements is the service rendered, and unless records are kept it will not be possible to judge of the serviceability of such improvements.

In the past, owing to a lack of records of actual operating conditions, the capacity of the pumping plant and the character of the machinery have varied widely on the different districts. The data herein published as to amount and cost of pumping should enable those in charge of the design and operation of such improvements to judge better of the requirements. These records will become of much greater value if they are continued over a long term of years and if they are extended to include all districts drained by pumps.

The following form is recommended as one including the essential features of daily operations.

FORM FOR DAILY PUMPING RECORDS.

(Date)_____ 191____.

Hour.	Suction gage.	Discharge gage.	Speed of pumps.			Start pump.	Stop pump.	Flow meter. Gallons per minute.		
			No. 1.	No. 2.	No. 3.			No. 1.	No. 2.	No. 3.

One page should be used for each day. The gages in the reservoir and the discharge canal should be read before starting and again about one-half hour after starting. If practicable, all items should be entered once each hour. Other items that might affect the operation of the plant, such as improper canals or seepage through levees, should be noted.

Expenses of operation should be kept carefully and classified under the following headings: Fuel, labor, supplies, repairs, and superintendence. The records should be kept in such a form that the totals for each month and year can be determined. The cost per acre per year can thus be obtained, but to determine the cost of removing a certain unit of water the capacity of the pumps at the various speeds and lifts should be determined by testing. The above form provides for such data that the amount of water pumped can be

calculated. If such records are kept on each district they will show whether the pumping plant is being operated properly, and they will enable future drainage improvements to be designed much more intelligently than heretofore.

UTILIZATION OF LAND.

In general, the water is lowered as rapidly as possible on these marshlands when they are first reclaimed. The lateral ditches are then cut and complete drainage of the soil obtained. Owing to the soft, spongy nature of the soil, it can not be cultivated immediately after drainage with ordinary farm animals and machinery. The work of reducing the soil to suitable condition for ordinary cultural methods belongs properly to the work of reclamation. As already mentioned under the detailed descriptions of the typical districts, the first cultivation of the land must be done with special machinery. After the land is cleared of grass the extra large disk plow has been found the best means of plowing it. These plows must be mounted on wheels of considerably more than the usual width. The tractor which draws these plows is the principal factor in doing the work successfully. Plate I, figure 1, shows a type of tractor which has been very successful. It is the type which was used almost exclusively on the plowing of the New Orleans Lakeshore Land Co. tract. As shown by the picture, the apron wheels are wide and exert only a small unit pressure on the soil, at the same time affording a very large tractive area for pulling. The body of the tractor is set well above the surface of the ground. This is an essential feature, for when the apron wheels sink into the ground, if the clearance of the body of the tractor is small the framework will rest on the ground, and further progress will be checked. Following the first plowing it is customary to pulverize the ground thoroughly with a double-disk harrow drawn by the same type of tractor. With ordinary weather conditions it is usually possible to place ordinary farm animals on such soils two or three months after they have received the above-described treatment. Where the land is especially soft it probably will be necessary to equip the feet of the animals with "bog shoes."

The first plowing of the land should not be attempted until it is fairly well drained. Lands that are especially soft may have to be drained for several months before they can be plowed, although much will depend on the time of year and the amount and distribution of the rainfall. As much progress is made in cultivating these raw lands in one dry year as in two wet years. The transforming of the dry, raw land to a cultivated field has been one of the most unsatisfactory and expensive operations in the reclamation of these lands. This has been due principally to the use of improper machinery and the attempt to plow the land before it was sufficiently drained. However, methods have advanced so far, and the special machinery necessary for the work has been so well worked out, that it is possible to make this transformation with reasonable expense.

Usually the first crop planted is corn. Frequently this is planted by corn planters drawn by the above-described tractors. In the average district it is possible to cultivate the first crop by ordinary methods. Following the first crop of corn a wide variety of crops have been grown successfully. The heavy percentage of vegetable material makes it easy to maintain a mulch of dry soil on the surface, and by proper management of the pumping plant the stage of water in the canals and ditches can be so controlled that the water is not reduced too great a distance below the surface.

FINANCIAL.

In its original state much of the prairie land is worthless, its only usefulness being in that it serves as a trapping and hunting ground. Its present market value is due to possibilities of reclamation rather than to any present usefulness and is more or less speculative. The value of the land varies according to the completeness and permanence of the drainage improvements, as well as according to its original character. A wide variation exists in the quality of the improvements, especially in the pumping-plant equipment. The cost per acre of reclaiming the various districts depends on natural conditions, the completeness of reclamation, and the character of the drainage improvements. The usual variation in the cost of such reclamation is from $30 to $45 per acre.

SUCCESS OF DRAINAGE.

The drainage of these lands has been uniformly successful, and from the drainage engineer's standpoint the work is now well past the experimental stage. Where successful drainage has not been attained it has been due to insufficient and poorly constructed improvements rather than to inherent and insurmountable difficulties. On some of the districts the improvements have been installed without competent engineering advice and services, and while successful drainage has been secured in some such cases, it was not secured with the greatest economy. The earlier faults were due principally to attempts to drain the land too cheaply. This has been demonstrated to be false economy, and the present practice is almost uniformly of such a grade as will ultimately result in the complete drainage of the lands of this section.

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LESSONS ON CORN FOR RURAL ELEMENTARY SCHOOLS.

By C. H. Lane, *Chief Specialist in Agricultural Education.*

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NEED OF STUDY OF CORN IN SCHOOLS.

For a considerable number of years more attention has been given by farmers to the production and improvement of corn than to any other grain or general farm crop, yet for no 10-year period has the average corn yield of the United States exceeded 28 bushels per acre. No State has averaged for any year over 54 bushels per acre, yet in practically every section of the United States yields of more than 100 bushels per acre have been produced. With the rapid spread of the work of boys' clubs the need of the study of corn in the schools has come to be better appreciated. The purpose of this bulletin is to furnish lessons for developing the real educational value of this study.

LESSON I.

Subject.—Kinds of corn.

Topics for study.—Points of difference between flint, pop, sweet, and dent corn. What is each kind mostly used for? How many

NOTE.—A revision of Farmers' Bulletin 617, the original edition of which was issued Oct. 22, 1914. Furnishes elementary lessons on corn and is of interest to rural-school teachers in all parts of the United States.

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kinds are grown in your school district? Which has proved most profitable? Which produces the larger annual crop, corn or wheat?

Exercises.—Have six or more pupils bring 10 ears of the best corn they can find at home. It would be better if all could bring the same kind of corn. Before the pupils attempt to select the most desirable ears for seed have them read the references. Then have the pupils select 20 or 30 of the best-looking ears for use in the lesson on judging corn.

References.[1]—Farmers' Bulletin 229, pp. 8, 9; 253,* pp. 6, 7; 415, pp. 4, 5; 537, pp. 18, 19; 553; 554.

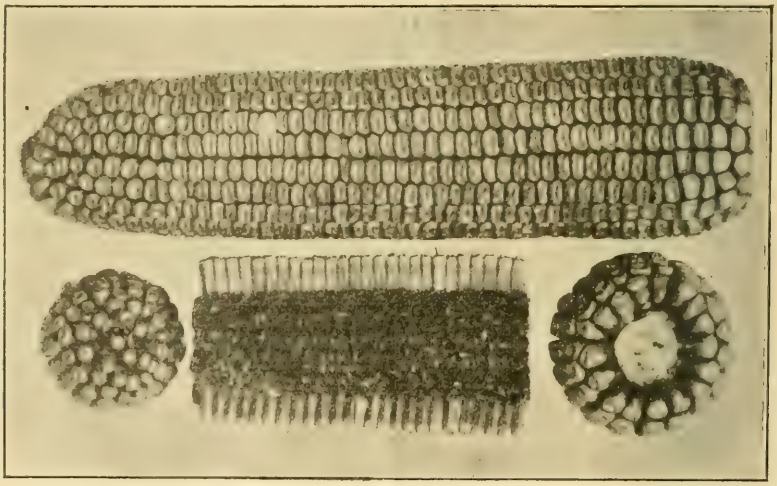

FIG. 1.—Characteristics of a well-developed ear of corn.

LESSON II.

Subject.—Judging corn.

Topics for study.—Object of corn judging. Value of "corn score card." Preparation of local corn exhibit. Learn how to judge of the maturity, vitality, and distinctness of type of corn.

Exercises.—Provide each pupil with 10 ears of corn and let him practice scoring, using the score card given. Each pupil should score a half dozen or more 10-ear samples before this exercise is passed by. Number all of the ears from 1 to 20 or 1 to 30, as the case may be, by tying to each a small numbered tag or sticking a numbered peg into the butt of each cob. Have each pupil provide himself with a score card ruled as shown below, providing one column for each ear of corn. The figures in the score card just to the left of the first perpendicular line show the number of "points" that should be

[1] Farmers' Bulletins marked with an asterisk (*) throughout this publication are not available for free distribution, but may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents a copy.

given for a perfect ear, e. g., if the pupil thinks ear No. 4 is nearly perfect in shape he would probably mark 9 in line 2, column 4, as shown in the table. Each pupil should examine carefully each ear of corn and put down on his score card, in the column of the same number as the ear of corn, his estimate of the qualities named on each line at the left, except line 4—vitality—which should not be filled in until after the seed is tested by the method explained on page 4.

Then compute the germinating value of the different samples on the basis of 20 for a perfect ear, as shown in the score card, and give each ear its proper rating in line 4 of the score card. Now add up the different columns of figures in the score card, and by means of the totals select the best five ears.

Score card for corn.

Points.		1	2	3	4	5	6	7	8	9	10
1. Trueness to type	10										
2. Shape of ear	10										
3. Purity of color in grain and cob	5										
4. Vitality, maturity, germinating power	20										
5. Tips of ears	5										
6. Butts of ears	5										
7. Uniformity of kernels	5										
8. Shape of kernels	5										
9. Length of ear	5										
10. Circumference of ear	5										
11. Furrows between rows	5										
12. Space between kernels at cob	10										
13. Proportion of corn to cob	10										
Total	100										

In order to understand the meaning of all the points listed in this score card it is well to write to the State agricultural college or to the State corn breeders' association, if there is one, for an explanation of the official score card used in your State; or it may be possible to get some one from the agricultural college or other agricultural school to come to your school or county teachers' meeting and explain the score card fully.

References.—Corn score card published by the State agricultural college. State corn breeders' association, if there is one.

LESSON III.

Subject.—Seed corn.

Topics for study.—What constitutes good seed corn? Where to obtain the best possible seed corn. How to gather seed corn. Treatment of seed immediately after gathering. Destroying weevils or grain moths. Winter storage of seed corn. Method of shelling.

Exercises.—Compare the methods outlined in Farmers' Bulletin 415 with those in practice in the vicinity of the school. What advantages for the various methods are apparent? See that the pupils

actually perform as many as time will permit of the operations for gathering and storing seed corn as are outlined in this particular bulletin. The United States Census Report of 1910 gives the national corn acreage as 98,382,665 acres. If seed selection could increase the yield 3 bushels each acre, what would be the increased income at 60 cents a bushel?

References.—Farmers' Bulletins 253,* 415.

LESSON IV.

Subject.—Testing seed corn.

Topics for study.—Importance of testing the vitality of corn. How to make germinating boxes. Care of the germinating box. Ears to be saved for seed. Grading of the seed ears.

Exercises.—Have the pupils study and make the germinating test as outlined in Farmers' Bulletin 253.*

Ask the pupils to test at home all the seed corn needed for the project field. Most parents will be glad to have the pupil conduct the seed testing at home, and this will be valuable practice. From the results of these tests have the pupils estimate what would be the gain (on the basis of recent yields) resulting from the rejection of poor seed corn. If the pupils will also test some ears from the corn cribs, they will probably prove that the crib method of curing corn is not suitable for seed corn.

References.—Farmers' Bulletins 253,* pp. 8–10; 415, p. 10; 537, p. 9.

LESSON V.

Subject.—Place of corn in crop rotation.

Topics for study.—(1) Reasons for rotation: (*a*) Different crops make different requirements of the soil; (*b*) root systems differ; (*c*) crops should be selected to suit varying seasonal conditions; (*d*) the culture of one crop prepares for a succeeding crop of a particular kind; (*e*) distribution of labor. (2) Corn in systems of rotation.

Exercises.—Draw plans of the home farm, showing fields, and write in each field the crops in the order in which they were grown during the last five years. Write to the State agricultural college for (*a*) a system of crop rotation in grain farming and for (*b*) a system of rotation in live-stock farming.

References.—Farmers' Bulletins 242*; 310,* pp. 12, 13, 21, 22; 325*; 422*; 537.

LESSON VI.

Subject.—Preparation of the seed bed.

Topics for study.—Soil conditions necessary. Time of plowing. Purpose of plowing. Depth of plowing. Characteristics of a good seed bed. When should cover crops be turned under for corn?

Exercises.—Show the effect of plowing under cloddy soil, or a large cover crop, on the rise of capillary water. Also the effect of disking a cover crop or heavy coating of manure into the surface soil before turning under. Use four lamp chimneys, numbered 1, 2, 3, and 4. Fill all to a depth of 5 inches with a sandy soil. Finish filling No. 1, using good loam soil. On top of the sand in No. 2 put 1 inch of wheat or oat chaff well packed down. In No. 3 put 2 inches of fine clods. Finish filling Nos. 2 and 3 with loam soil. Complete the filling of No. 4 by using a mixture of loam and the same amount of chaff used in No. 2. Set all chimneys in about 1 inch of water. Observe and explain results.

A field is 80 rods long and 60 rods wide. How many acres? How many days will it take to plow it, allowing $2\frac{1}{2}$ acres a day as fair work for man and team? What would be the cost, charging local prices?

References.—Farmers' Bulletins 414, pp. 6, 7, 13, 17, 18; 537, pp. 12, 13, 14; 729, pp. 1, 2, 3. Farmers' Bulletin 773 gives on pp. 10–12 instructions on preparing land for planting corn under droughty conditions.

LESSON VII.

Subject.—Fertilizers and how to apply them.

Topics for study.—What are the indispensable requirements for a good corn yield? What is one of the surest fertilizers for producing a large corn crop? Why? How many tons of well-decomposed and moist barnyard manure may you safely apply? Manure containing stalks or undecomposed straw may reduce the corn yield. Explain. When should the manure be applied? What element of plant food is needed most by the soils for profitable corn production in your district? What necessary elements of plant food do commercial fertilizers supply? When are such fertilizers likely to be profitable and how should they be applied? Show the relation between profitable corn production and the use of lime, ground phosphate rock, and legumes on different kinds of soils. Name the steps necessary in building up the soil permanently on a run-down farm in your district.

References.—Farmers' Bulletins 44*; 192,* p. 5; 326,* p. 10; 398*; 414, pp. 12, 13; 537, pp. 10, 11; 729, pp. 3, 4, 5, 6, 7, 8.

LESSON VIII.

Subject.—When and how to plant field corn.

Topics for study.—At what time do the best farmers in your school district plant their cornfields? What is the old Indian rule? Why do the farmers not plant earlier? Why do they wish to plant corn as early as it is safe? Do most of them plant in continuous drills or

in hills? How far are the rows spaced apart? How far apart are the hills in each row? What is a "check rower"? How many kernels are planted in a hill? What is the secret of a prize-winning corn crop?

Exercises.—How many kernels are needed to plant an acre of ground? How many ears does that require? How many farmers in your district take their seed ears from the corncrib in the spring? Is there any certain way to find whether they will grow before planting them in the field? (See p. 4.) How many kernels in a quart of good shelled seed corn of the kinds commonly grown in the locality? How many quarts are needed to plant an acre? How many bushels for 40 acres? How many bushels of shelled corn do the best farmers in your district raise on an acre? How does this compare with the best yields made by the boys' corn clubs in your State?

References.—Farmers' Bulletins 414, pp. 19–24; 537, pp. 14, 15; 729, pp. 8–13. Farmers' Bulletin 773 gives on pp. 12–16 instructions on time and methods of planting corn under droughty conditions.

LESSON IX.

Subject.—The cultivation of corn.

Topics for study.—Purposes of cultivating corn. Importance of first cultivation. Shallow cultivation. Meaning of a soil mulch. Purpose of a mulch. Proper depth. Frequency of renewal.

Exercises.—The effect of a soil mulch may be shown by filling two cans or flower pots with soil and planting corn. When the plants are 3 inches high cover the soil in one pot with a layer of coarse sand or granular dry soil to a depth of 1 inch. Place in the window and observe which plants first show the need of water.

If a man and team harrow 15 acres a day, how long will it take to harrow a field twice which is 80 rods long and 60 rods wide? What would be the cost, charging local prices?

References.—Directions for the proper cultivation of corn are given in Farmers' Bulletin 229 for the "Corn Belt States," and in Farmers' Bulletin 81* for States farther south. Farmers' Bulletin 729 gives on pp. 13–19 instructions on how to cultivate corn in the Southeastern States. Farmers' Bulletin 773, pp. 16–18. Farmers' Bulletin 537, pages 16 and 17, gives general directions for cultivating corn with a view to producing a maximum yield. Nearly every State has one or more bulletins on this subject. These should always be procured from the State agricultural college and studied in the class.

LESSON X.

Subject.—Corn diseases and pests.

Topics for study.—The corn root-louse. The chinch bug. The corn ear-worm. Weeds. Corn smut. The larger cornstalk-borer.

Exercises.—Find out from the farmers in the district whether corn has any serious pests, such as birds, insects, or diseases. If possible, have the pupils collect and preserve for the school exhibit local corn diseases and insect pests.

References.—Farmers' Bulletins 54*, pp. 18–23, 29, 30; 78*, p. 27; 537, pp. 15, 16; 634*; 733; 739.

LESSON XI.

Subject.—The food value of corn.

Topics for study.—Is most of the corn in your State fed or shipped? Which is cheaper, to ship the corn or to ship an animal that was fed on it? About how many bushels of corn are required to feed a 250-pound hog? How much would it cost to ship the corn to the nearest large stock market—Chicago, Omaha, Kansas City, or Buffalo? To ship the hog? In addition to its value as feed for stock, corn is largely used as human food. In what ways is it used as a food? What products are manufactured from corn? What ones have you seen? What samples of them do you have in your school museum?

Exercises.—When you sell $10 worth of corn from the farm you sell $3.78 worth of fertilizer; when you sell $10 worth of cattle you sell $1.18 worth of fertilizer. Which would be more profitable—to sell corn or to feed it to cattle and sell the cattle? Which method of farming would keep the land in good condition longer? Have the pupils study and recite on Farmers' Bulletins 56, 65, 97, and 122. All these deal with some phase of feeding corn to farm animals. The girls in the class will be interested in studying the value of corn as a food for human beings, as discussed particularly in Farmers' Bulletin 565.

References.—Farmers' Bulletins 97*, pp. 9–12; 249; 281*, pp. 18–22; 298; 553; 554; 559; 565.

LESSON XII.

Subject.—The botany of corn.

Topics for study.—Corn flowers: Does the corn have flowers like wheat? Where are the stamens in corn? Where are the pistils? What is the yellow powder that one sees on the ground just as the silks begin to show? Why so much of it? Why is dry weather particularly bad for corn at this time? When a cornstalk grows in a place by itself what kind of an ear does it have? Why is this? Open an ear of corn that has just "silked out." Follow the threads of silk. Where are they attached to the kernels?

(The corn stamens are normally borne in the tassel. The silks and the kernels to which they are attached are the pistils. The pollen must fall or be blown from the tassel to the silk in order to fertilize

the kernel and make it develop. There must be a great abundance of pollen, because so much is lost. Each silk extends to one kernel only.)

The corn leaves and stalks: How are the leaves arranged on the stalks? What is the position of the ears with respect to the leaves? Notice that the margin of the leaf is longer than the middle of the leaf. This makes the leaf wavy. Would this help to prevent the wind from tearing the leaves? Does the wind damage corn leaves much in your country? What do the corn leaves do in very dry weather? Is this an advantage to the corn plant? How? Cut across a cornstalk. Notice the threads that run through it. Where are they thickest—in the middle or near the outside of the stalk? These threads are woody bundles called fibro-vascular bundles. Split a stalk and see if they go the whole length of it. Do they extend into the leaf? Cut out about 3 inches of a stalk between joints. Put one end of this in water and blow through it. Through what part of the stalk does the air go? The chief function of the fibro-vascular bundles is to conduct the sap up and the prepared food down in the plant. They extend into the leaves and become the veins, and thus help to make up the leaf framework.

The joints of the cornstalk are called "nodes," and the spaces between them are called "internodes." If a stalk of corn is broken down, at what point does it begin to straighten up again? Is the node, then, of the same length all around? Which side of the internodes is flattened or channeled? Is it the same side all the way up? What other crop plants have nodes and internodes like corn? Is corn a grass plant? Is wheat, flax, clover?

Corn ears: On which side of the internode is the ear always found? Is a leaf sheath always found on the other side of the ear? Suppose the ear were borne on the end of a long branch, with leaves arranged just as they are on the stalk. Now, if you could "telescope" this branch from tip to base, so that it would be only an inch long, would the leaves, then, have the place of husks around the ear? Are the husks corn leaves? What is the short branch that bears the ear called? How does it come to be so short? Could it hold a large ear up off the ground if it were very long? Is it better to have the shank hold the ear upright or allow the tip to hang down a little? Why? What is the advantage in having the tassel at the top of the stalk? Which would be the better kind of corn to cultivate—the sort we have now, or one with long stalks and branches and with both stamens and pistils at the ends? Do we sometimes still find a few kernels in the tassels or parts of the tassel attached to the ear? (Have such specimens collected at husking time and brought to the school.) Are they the best kind of corn to plant? (Try it and see.)

Corn roots: Dig down around a hill of corn and see how near the surface the roots grow. How far do they extend from the stalk? How deep could the cultivator go without hurting these roots? (Fig. 2.) About the time that the corn tassels come out the "brace roots" appear. Find some of these roots. What is their use?

Exercises.—Bring a sufficient number of cornstalks into the schoolroom, or, better still, go with the class to a field of standing corn. Make notes of your observations in answer to questions on Topics for Study.

References.—Farmers' Bulletin 229. Textbooks on Elementary Agriculture.

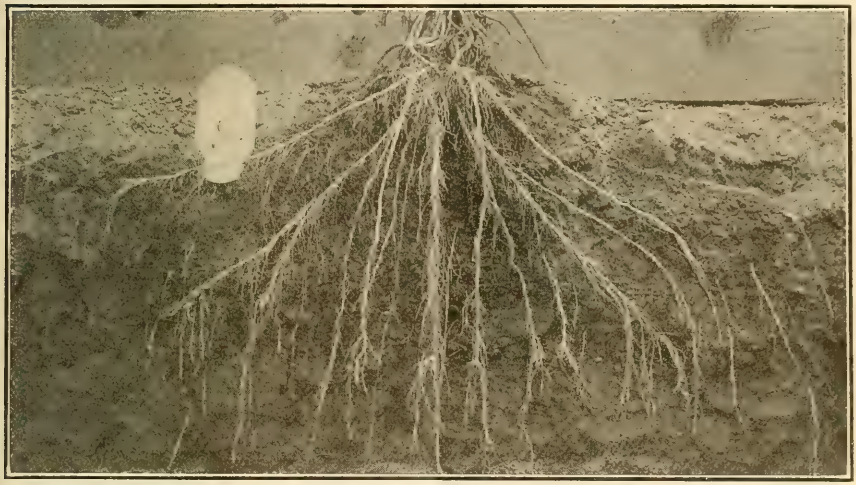

FIG. 2.—Distribution of corn roots, showing how late deep cultivation affects the roots.

ADAPTATION TO COMMUNITY.

The lessons should be adapted to the particular needs of the district served by the school. In order that the instructor may have accurate information as to the extent of corn production and the methods used, he should have the students assist him in making a survey of corn production. If this survey is made carefully it will assist in arousing interest as well as furnishing a basis for adaptation to local conditions. The following is suggestive of a report form to be used in securing information:

Corn survey.

No.	Name of farmer.	Location of field.	Purpose for which grown.	Acres.	Yield.	Special methods.
1	.....	.....	.....	.....	.....	.....
2	.....	.....	.....	.....	.....	.....
3	.....	.....	.....	.....	.....	.....
Etc.	.....	.....	.....	.....	.....	.....

USE OF TEXTS AND REFERENCES.

It should be obvious that if the lessons are to be adapted to both the students and community, a textbook can not be followed slavishly. In making adaptations, State publications and the bulletins of this department may be used to advantage. The teacher will find the recent editions of books devoted entirely to corn helpful for his personal use and for students who may be assigned special topics. Students having an interest in special phases of corn production, such as the production of pop corn, sweet corn, or corn for silage, may be assigned these subjects as special topics for written reports to the teacher or oral reports to the class. Topics such as the history of corn, methods of marketing, and the manufacture of corn products, which the entire class may not have time to study extensively, may be assigned also as special topics.

USE OF ILLUSTRATIVE MATERIAL.

In the field.—In many respects the best place to study corn is in the cornfield. Opportunity should be sought to observe the growing of the plant under natural conditions. Field trips may be planned in the spring to study methods of soil preparation and planting. The class should become familiar with the working of modern planting machinery. In the fall trips may be made to study the working of harvesting machines. Although growth has stopped at this season, it is a good time to study the effects of different methods of planting and culture. Each trip should be planned with a definite aim and each student should be required to take notes and make a written report. Students should be given every encouragement to make individual observations in the field and to report such studies to the teacher or to the class. As the growth of corn takes place mostly during the time of summer vacation, special inducement should be made to get students to study corn and methods of cultivation at this time, even though they may not have a corn project. Students should be required in the class recitation and in written papers to report methods used on the home farm.

In the classroom.—It is often more convenient to bring material into the classroom than to study it in the field. The school should be provided with an abundance of concrete material and have a place to keep it safe from mice and other pests. Specimens should be available to show the different types of corn and the leading varieties which are suitable to the district. Sample ears showing corn of different degrees toward perfection should be available for judging purposes.

Such material may be supplemented with good illustrations showing the growth of the plant as well as types and varieties. Drawings and diagrams may be made upon the blackboard to assist the students in visualizing the lesson. A chart similar to the one show-

ing the relative value of corn (fig. 3) may be drawn to show the production of corn by States, or this may be shown with dots upon an outline map of the United States.[1] Diagrams of kernels of corn showing the composition of different varieties and strains are included in some of the State publications. Such diagrams may also be copied on the blackboard. Permanent charts of convenient form may be made by using a rubber stamping outfit upon light-colored window shades. Fasteners may be fixed upon the wall to hold the chart; then when it is needed no longer it may be rolled up and put out of the way.

OBSERVING CORN DAY.[2]

To make this day a success, not only the children, but the parents, must be enlisted. The social element in it is very important. Every parent must be so interested that he will feel he must be present. Plan for an entire day given to the special occasion. If there is one in the vicinity who can give anything valuable about agriculture, secure him as a speaker. If this is done, have two programs, one in the forenoon for the speaker and one in the afternoon, when the children shall take the prominent place.

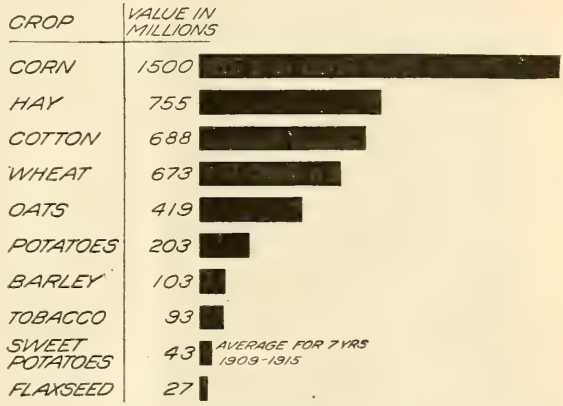

FIG. 3.—Chart showing value of ten important crops in United States.

For the children's program plan to show the results of the work done in the study of corn. Let it include the best compositions written on the more interesting phases of the work. The History of Corn, The Indian Corn Dance, The Importance of Corn in America, The Development of Breakfast Foods, The Possibilities in a Cornstalk, How Six Ears Went to Market, The Story of a Stalk of Corn, Number of Days of Work Needed for One Man and a Team to Raise and Harvest an Acre of Corn are suggested as additional subjects.

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[1] See Thirteenth Census of the United States (1910), Vol. V, Agriculture, for statistics on corn production and for suggestions as to showing statistics in graphic form. See also U. S. Dept. Agr., Bureau of Statistics Bul. 78 (1910), Agricultural Graphics, for maps showing production of crops and live stock in the United States and in the world. This publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 15 cents. For the latest agricutural statistics with graphic illustrations see Appendix of Yearbook of the Department of Agriculture 1915, Separate 681.

[2] Adapted from Corn Day Annual, Schools of Illinois, 1913.

The history and work of the farmers' institute should be reported by one of the older pupils. Another should give an account of what the agricultural college is doing for the State.

If sufficient interest has been aroused, a corn-judging contest might be held. For judging the corn exhibits prepared by the pupils secure some man who has studied corn judging. Be sure to make this a feature of the day, making the announcing of the results a part of the program.

Music should not be omitted from the program. Some patriotic music should be included, as should the State song.

The following program may be suggestive:

Quotation on Corn.
The Gift of Mondamin.
Hiawatha Blessing the Cornfields.
The Feast of the Mondamin.
The Corn Song.
The Place Corn Has in Our History.
From a Tiny Grain to a Mighty Ear.
The Huskers.
The Husking Bee.
Maize, Our National Emblem.
What I Think is a Good Ear of Corn.
Columbia's Emblem.
Why I Think Corn and Boys are Similar.
The Uses of Corn.
"When the Frost is On the Pumpkin."
Why Corn Should Be Our Emblem.

Plan to have dinner at the school, and use every device possible to make it a corn dinner. There are many ways in which corn can be prepared which will add to the effectiveness of the plan. If the number of people is not too large a splendid lesson in art would be the making of place cards and decorating them with some corn design. If these are not made, souvenirs of the day should be made by the pupils, carrying out the corn idea. This is one real way to teach decorative art.

For a language lesson prepare written invitations to the patrons of the school. Perhaps the form side of notes of invitation will be more vividly taught then. Be sure to include the local editor in the list of invitations. Have a report of Corn Day written by some of the pupils for the local papers.

The decoration of the school room should not be neglected. Some suggestions as to using blackboard drawings, booklets, corn products, and other work of the pupils have been given. Use some fine specimens of corn in completing the decorations. Grains of yellow, white, and red corn are full of possibilities, as are the stalks. The rooms should be decorated so as to give joy and impress the thought that the man who raises a good crop of corn is engaged in an exalted work.

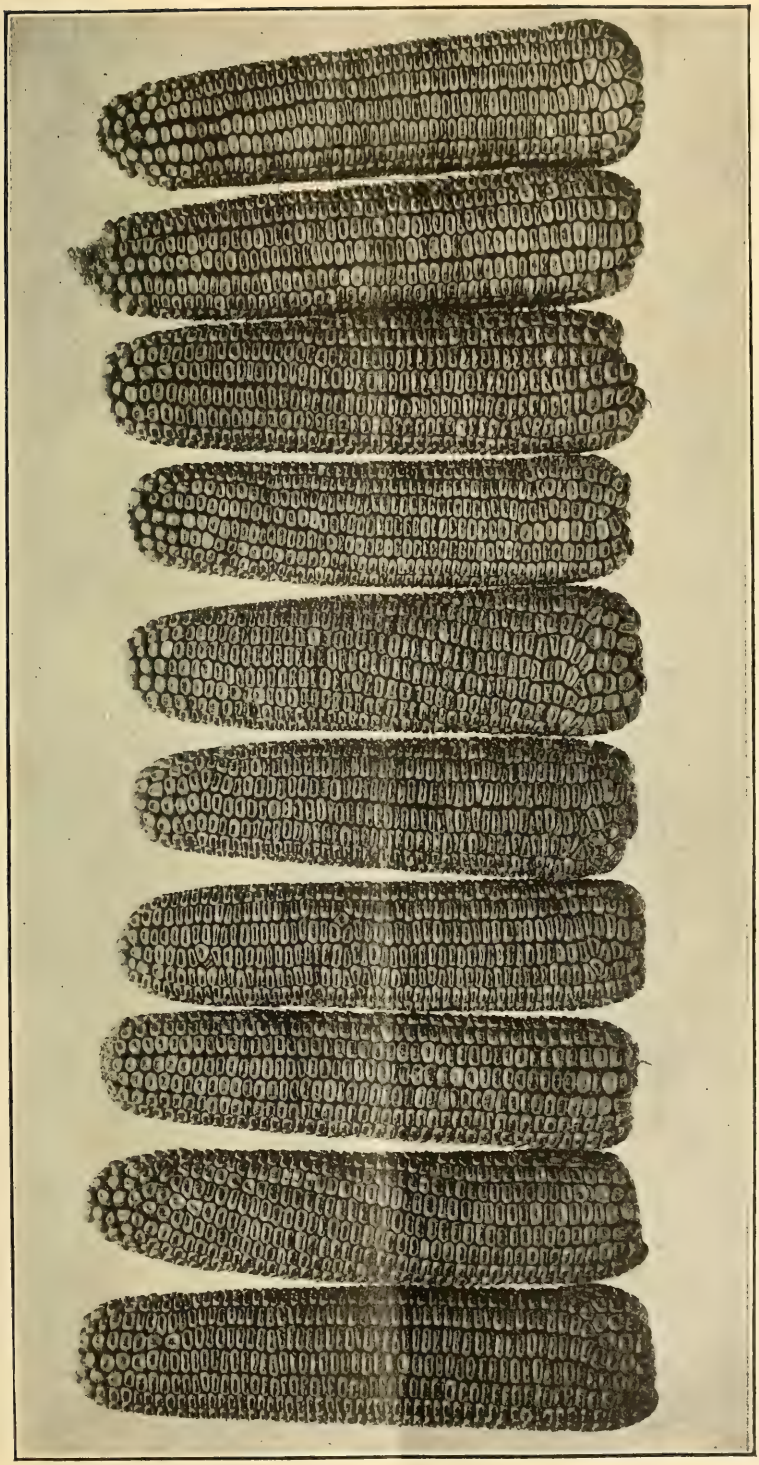

FIG. 4.—A poorly selected corn exhibit. The second ear has a pronounced "twist" in the row of kernels, and the ninth ear has a very poor tip.

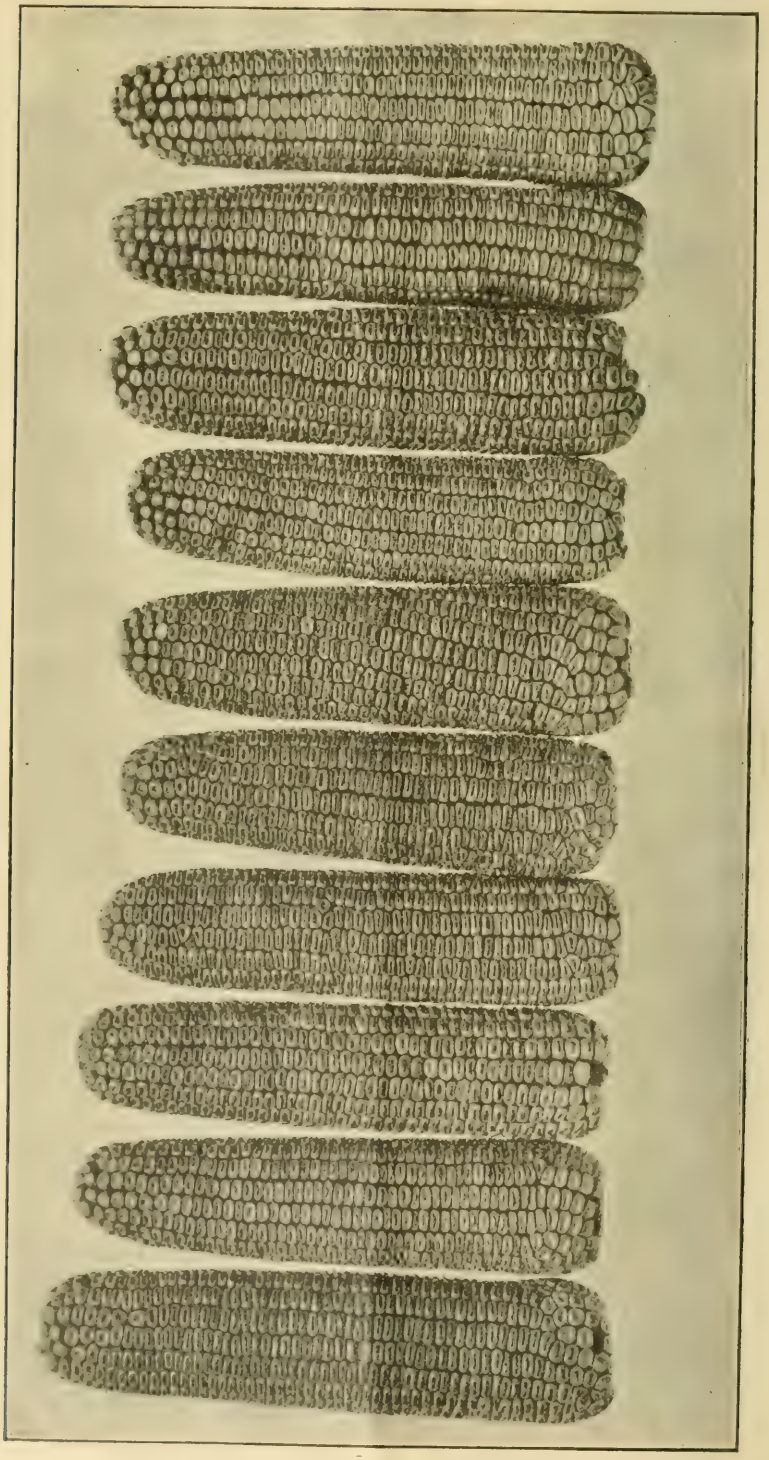

FIG. 5.—A well-selected exhibit. The substitution of two good ears for the second and ninth of figure 4 gives a satisfactory degree of uniformity to the entire set.

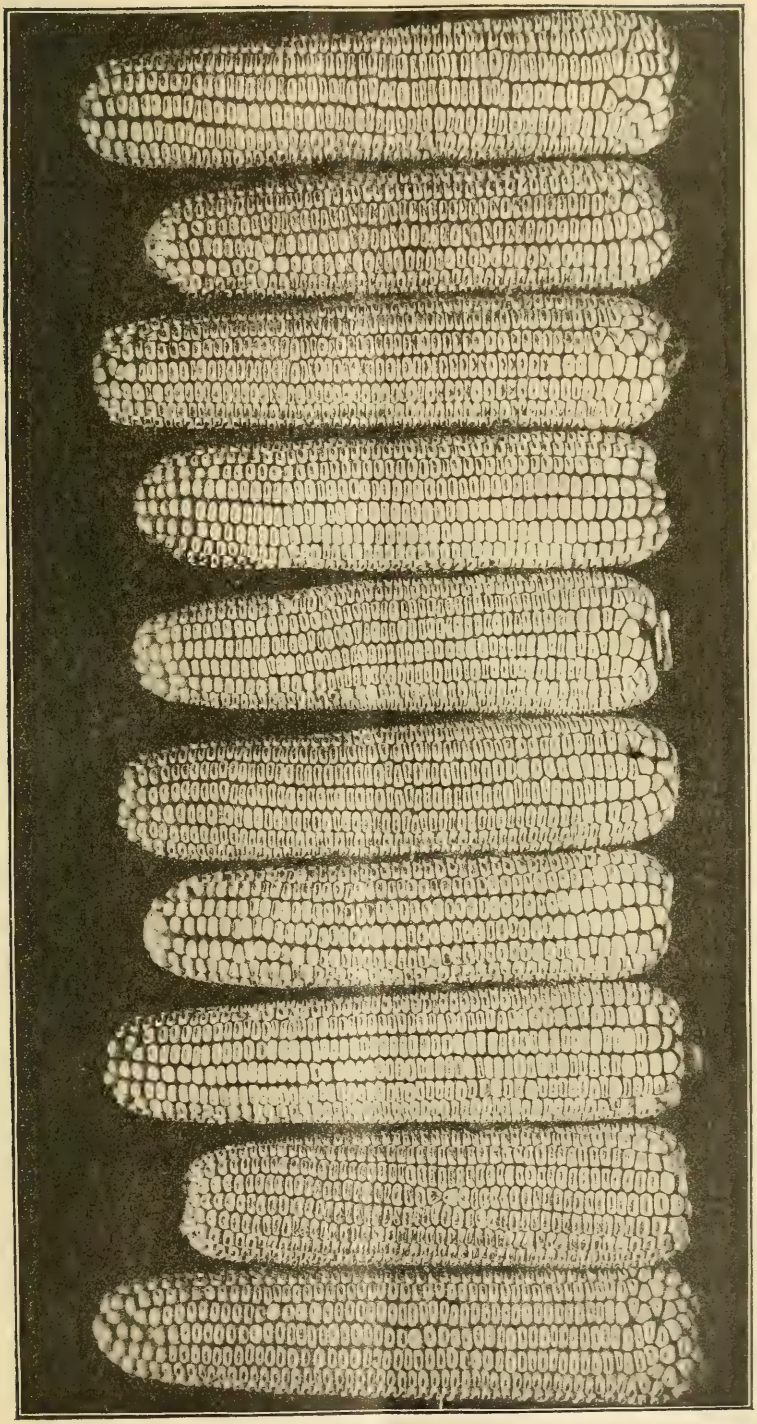

FIG. 6.—A poorly arranged exhibit, decidedly lacking in uniformity of appearance.

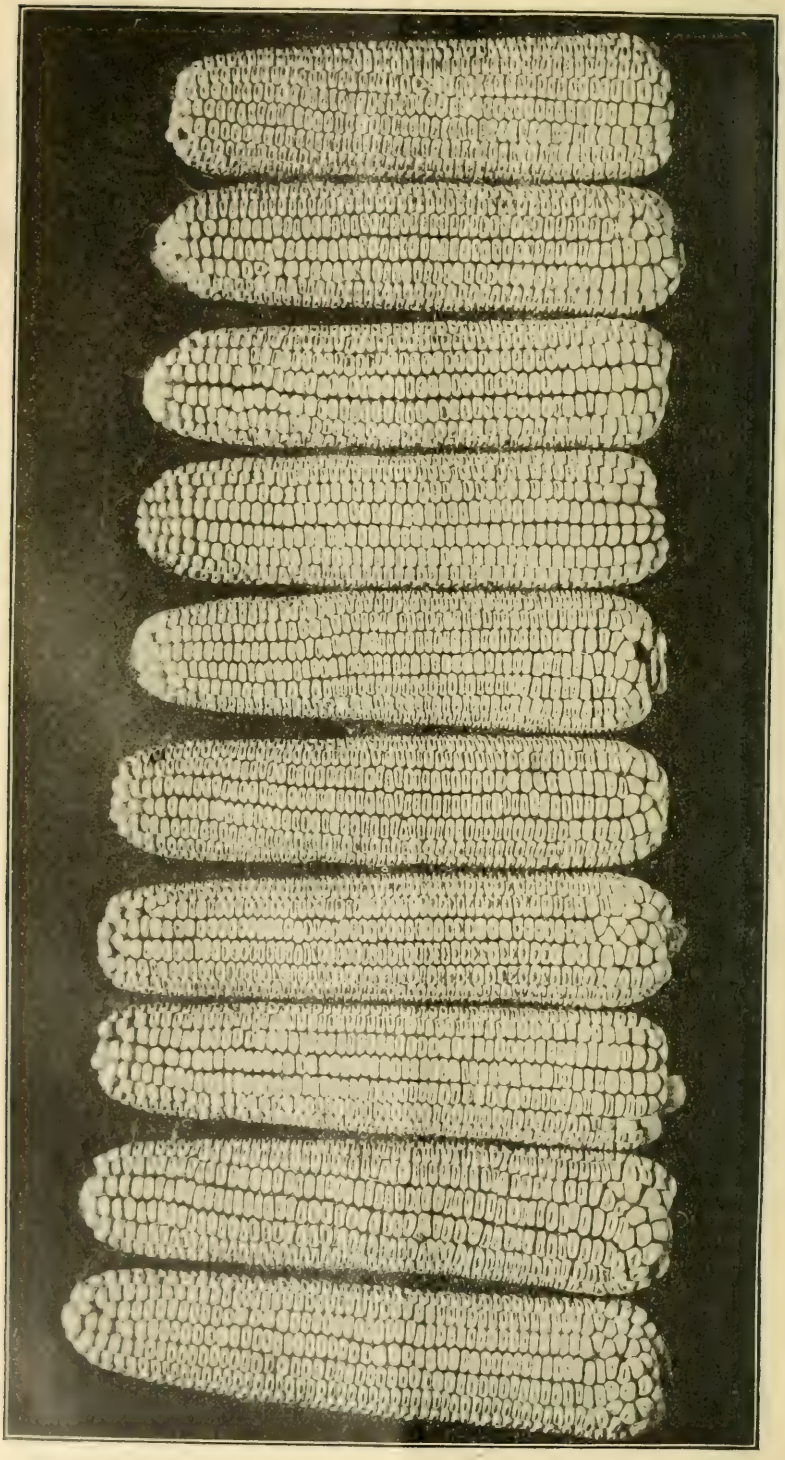

FIG. 7.—The same exhibit properly arranged; ears nicely graduated as to length.

The following letter might be sent to all patrons of the school:

DEAR FRIEND AND PATRON OF THE ——— SCHOOL:

The teachers and pupils of ——— School, in response to the suggestion of the State superintendent, have decided to have, on ———, a "Corn and Other Products Day," and we cordially invite your cooperation and attendance. Bring good samples of corn, fruit, potatoes, tomatoes, poultry, and other home or farm products that you care to exhibit, and help us to make it a day of educational value. A special program, participated in by the pupils and others, will be a feature of the day.

Please bear in mind that this is your school and that your cooperation and presence will be both a help and an inspiration.

Sincerely yours,

———, *Teacher.*

SELECTING THE EXHIBIT FOR CORN DAY.

The exhibit from one person usually consists of 5 or 10 ears of corn. Sometimes a 10-ear exhibit to represent the entire local school is made up by selecting that number of ears from the best ones brought in by all the members of the school.

One very important thing to observe in choosing and arranging all such exhibits is the principle of *uniformity*. This is sometimes indicated in score cards by the phrase "uniformity of exhibit." In the score-card form shown on page — it is covered by "trueness to type" and "uniformity of kernels." These phrases all mean that in order to get a high rating all the ears in the set must *look alike* as nearly as possible. A corn judge often discards a set of 5 or 10 ears from any further consideration simply because the exhibitor included among them one ear that was an inch longer than the rest, or of a different shade in color, or that had a different number of rows of kernels, or kernels of noticeably different shape or size than those on the rest of the ears. Sometimes the size of cob in one ear differs from all the others, or one ear is crooked or has "twisted" rows of kernels, while all the rest are straight.

Any of these defects spoil the *uniformity* of the set and cause the set to be marked down severely. It is better to select 10 ears that are not the very best, but are *alike*, than to include one ear that is either much better or much worse than all the rest in the set. Pick out the best 40 or 50 ears you can find, and then from these, by careful measurement and comparison, select for your exhibit the 5 or 10 that are nearest alike.

The unfavorable impression made by a poorly selected or poorly arranged exhibit of 10 ears is clearly illustrated in figures 4 and 6 (pp. 13, 15). Without discarding any ears from the best 10 selected they can always be *arranged* in one *best* order, from left to right, so as to present whatever excellence they have in the most favorable view.

(See figs. 5 and 7, pp. 14, 16.) The corn judge may change this order before giving his final verdict, but in any case he will be disposed to give the exhibitor credit for knowing the advantages of a good arrangement. Furthermore, a good arrangement of the ears in an exhibit saves time for the judge, and that, too, is in the exhibitor's favor if the judging must be done rapidly.

SUGGESTIVE CORRELATIONS.[1]

Reading.—Utilize for supplementary reading Farmers' Bulletins, agricultural college bulletins and circulars, textbook references, and articles in farm papers and magazines dealing with the subject of corn.

Spelling.—List the new words related to the corn industry and assign them as spelling exercises.

Language lessons.—Written reports of field observations, narrations on selection of seed in the field, and descriptions of germinating boxes; plant diseases and insect pests supply material for written exercises. The pupils should have much practice in this work to the end that they may grow in power to express their ideas truthfully, systematically, adequately, and interestingly.

The pupils should be required to write letters ordering seed catalogues and asking for quotations in the prices of seed corn. In these letters strive for correct form, good composition, and courtesy in expression.

Drawing.—Make drawings of ideal and faulty specimens of the common varieties of corn grown in the district. Collect, name, and make drawings of common weed and insect pests of corn. Pupils should be encouraged to illustrate their descriptions by free-hand sketches on the blackboard. Make drawings of the important parts of machinery used in corn culture. In this connection emphasize the learning of the names and uses of implements and their parts.

History.—Study the history of the varieties of corn common to the community as to their origin, the time and circumstances of their introduction, and the success with which they have been grown. Corn culture during colonial days should be studied carefully. Study the history of weeds, insects, and fungus diseases of corn as to origin, introduction, spread, damage done, and methods of combating.

Geography.—Locate on the map of the United States the 10 States that lead in corn production. Name another important agricultural industry of these States depending largely upon the production of corn. Compare the climate and leading agricultural product of other States and other countries having the same latitude as the

[1] See U. S. Department of Agriculture Bulletins 132, Correlating Agriculture with the Public School Subjects in the Southern States, and 281, Correlating Agriculture with the Public School Subjects in the Northern States.

corn States. Explain the cause of the difference in climate and agricultural products. What cities of the United States are the leading markets and distributing points of the corn crop? Compare corn with other grains, both as to total yields and as to amounts exported.

Arithmetic.—Have pupils report these facts from their homes: The number of acres planted to corn, the prevailing rent price per acre, the total yield, the amount of fertilizers used per acre, the labor required to prepare the seed bed, cultivate, and harvest the crop. From these facts develop problems to determine the average cost of growing an acre and of producing a bushel. Find the average yield per acre and its value based on local prices. Is the corn of the community grown at a profit or loss? Find the per centum profit or loss.

WASHINGTON: GOVERNMENT PRINTING OFFICE: 1918

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 654

Office of the Secretary
Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ June 14, 1918

FARM ORGANIZATION IN THE IRRIGATED VALLEYS OF SOUTHERN ARIZONA.

By R. W. Clothier, *Agriculturist.*

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OBJECT OF INVESTIGATIONS.

This bulletin presents the results of a farm survey of 627 farms conducted in the three larger irrigated valleys in southern Arizona. The general object of the investigations was to determine those factors of business management and farm practice which influence financial returns and lead to success or failure, in order that recommendations might be made that would lead to general financial improvement among all farmers in the districts studied. The valleys are located as follows (see fig. 1): Salt River Valley, in the southeastern part of Maricopa County; Gila Valley in Graham County northeast of the Pinolenos Range of mountains; and Yuma Valley, in Yuma County, in the southwest corner of the State.

SUMMARY OF RESULTS.

The facts brought out by this study indicate that the selection of farm enterprises is of great importance and should be carefully studied both by new and old settlers. Over 25 per cent of the farms in the three valleys failed to pay current interest rates on investment, owing largely to a farm organization based primarily on relatively unprofitable enterprises.

Dairying was found to be the most stable as well as the most popular enterprise in the three valleys, contributing 67.7 per cent of the

total receipts on 178 farms out of a total of 627, and contributing 24.9 per cent of the total receipts of all the farms studied. It is also one of the most profitable enterprises, both farm income and farmer's wages rising with the percentage of receipts from dairying. Dairying can be made more profitable by improving the system of pasturing and keeping up the thrift of the alfalfa fields; also by improving the dairy herds.

FIG. 1.—Map of Arizona, showing location of regions studied (shaded areas).

Growing alfalfa for hay ranked next in popularity to dairying, when judged by the number of farmers engaged in it, but it was not so profitable except with maximum yields, which must approach 7 tons per acre, and at prices approaching $10 per ton. Both farm income and farmer's wages decrease as the percentage of receipts from hay increases.

The production of alfalfa seed for the market is highly profitable in Yuma Valley, but the enterprise has not been developed in the other two valleys.

The sale of pasture is an important side line to hay farming, but when made a major enterprise is not as profitable as hay farming.

Fattening beef cattle for the market is a popular and profitable enterprise on the larger farms.

The enterprises that do not depend upon alfalfa for their existence are cotton farming, grain farming, fruit farming, poultry farming, and trucking and gardening.

Cotton farming is a new enterprise, based on an acclimatized variety of Egyptian cotton which promises to be a profitable rotation crop with alfalfa.

Grain farming is relatively profitable only on the cheaper lands. Poultry raising is a profitable enterprise, especially on the small farms, and is an important side line on farms of all sizes.

Fruit farming is relatively profitable on the small farms, though fruit lands are so highly valued that they often fail to pay current interest rates on their valuation. They furnish a relatively high standard of living and a relatively low standard of wages to the farmer.

Trucking and gardening are unpopular, and are believed by most of the farmers in the districts to be unprofitable. Cantaloupes are highly speculative, sometimes returning high profits and sometimes failing to pay freight bills on shipments.

Diversified farming when based on dairying or poultry is relatively more profitable than hay farming, but not as profitable as dairying. It has made its best development on farms of medium size where dairying and poultry are strongly emphasized among the diversified enterprises.

Some adaptation of type to size of farm is necessary; poultry raising, dairying, and fruit farming being required on small farms, dairying being adapted to the farms of medium size, and the beef-cattle enterprise giving the best returns on the larger farms.

The amount of capital required varies with the size of the farm and the enterprises to be selected. The farm income and labor income rise almost directly with increase in capital invested.

Farmers with little means find it more profitable to rent than to buy land, and the renter makes relatively much more for his labor, which is his chief asset, than the owner farmer. This is due to a low-renting value of land compared with its commercial value, landlords making an average of 4.87 per cent net on the valuation of their lands.

Here, as in most other farming regions, the size of the farm has a direct bearing upon the standard of living afforded the operator, and also upon the wages he receives for his labor. There is a constant and steady rise in both labor income and farm income as the average size of the farms rises from 11 acres in the smallest-size group to 530

acres in the largest-size group, and there is no indication that still larger farms would not continue to pay still larger labor incomes.

Here, as elsewhere, the minimum farm unit should be large enough to afford the farm family at least a comfortable living, with some margin for savings. Whether it should be large enough to pay "reasonable wages" for the farmer's labor is a matter to be decided by the individual concerned. The personal ability of the operator and the means at his command are factors that must be considered.

Small farms are more intensively farmed than large ones, but the large farms give better returns for a given amount of labor. One man manages eight times as many acres, five times as many live stock, and three times as much capital on the very large farms as on the very small farms; and this more than compensates for the greater returns per acre on the small farms. However, increasing receipts per acre pays on large farms, the farm income and labor income both rising as receipts per acre increase, even though the average area farmed decreases.

Of a total of 627 farmers, 466 managed their farms so as to make them pay an average of 13 per cent on the investment in addition to the farm contribution to the family living, while 161 farmers were able to make their farms pay but 5.9 per cent on the investment, the labor of the farmer himself not being included in expenses in either case. This difference was due almost entirely to differences in gross receipts obtained by the two groups of farmers.

It was found that gross receipts are influenced by the type of farming, the amount of working capital per acre, the number of acres farmed per man, the productivity of the land, and the quality of the live stock. All of these factors are largely within the control of the Arizona farmer.

GENERAL DESCRIPTION OF LOCALITIES.

SALT RIVER VALLEY.

Salt River Valley is the largest of the three valleys studied. It extends from the junction of the Verde River with Salt River to the junction of the Salt with the Gila River, a distance of about 50 miles. Its average width is approximately 20 miles. It contains somewhat over 200,000 acres of irrigated lands, about three-fifths of which are on the north side of the river.

The soils, being of alluvial origin, are deep, and vary in texture from light sands to heavy clays, or "adobe." They are fully described and mapped in a bulletin[1] issued by the Bureau of Soils of the United States Department of Agriculture.

The climate may be classified as subtropical. There is a long, hot summer and a short, mild winter. The heat in summer is greatly

[1] A Soil Survey in Salt River Valley, Ariz.

mitigated by a very dry atmosphere, and sunstroke is unknown. The nights are always cool, a range of 50° between day and night temperatures being not uncommon during the summer months. The following table shows the highest, lowest, and mean temperatures for each of the months during 21 years at Phoenix, which is approximately the center of the irrigated section:

TABLE I.—*Temperature data at Phoenix, Ariz. for 21 years, 1896 to 1916, inclusive.*[a]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
Highest	81	91	94	102	114	116	117	113	112	100	92	80
Lowest	16	24	31	37	39	49	63	62	49	41	28	22
Mean	50.0	54.4	60.5	66.6	74.8	84.8	90.4	89.0	81.4	70.2	58.7	51.9

[a] U. S. D. A. Weather Bureau, Summary of Climatological Data for the United States by sections, Section III, and later annual reports.

The rainfall averages about 7.27 inches per year. Most of the precipitation occurs during two short rainy seasons, one in July and August and the other during the winter months. The summer rains are entirely local in origin and character, while the winter rains are of a more general nature. The rains are seldom copious enough to take the place of irrigation, and crop production depends entirely upon irrigation for its water supply.

There is abundant evidence that this valley was once irrigated by ancient peoples, probably the ancestors of the semicivilized tribes of Indians now living in or near the valley. Old canals aggregating 150 miles in length have been located and it is estimated that at least 140,000 acres were under cultivation at that time. Much of the adobe and other heavy surface soils now found at different places in the valley probably were deposited from muddy water used for irrigation.

The modern development of the valley began in 1867 with the construction of the Swilling Canal. Between this date and 1892 a dozen or more canals were constructed which were about equally distributed between the north and the south sides of the river. With but few exceptions the dams and headgates for these canals were of a temporary nature and were washed out with every flood. The dam for the Arizona Canal (see fig. 2), the largest one in the valley, was the only one which had any semblance of permanency, and it was partly washed out in 1891 and completely destroyed by the floods of 1905. These conditions resulted in chronic water famine. When the river was full of water there were no dams to divert it to the land, and when there were dams in the river there was not enough water to irrigate all the lands under the canals. Water rights for 151,360 acres of land were adjudicated in 1889,

but the census of 1890 reported only 327 irrigators in the valley and only 35,212 acres under cultivation.

The development of agriculture under such conditions was fitful and uncertain. The raising of hay, grain, and live stock became the leading enterprises. Several corporations were organized for the development of the fruit industry on a large scale but all resulted in failure, and only a few of the remnants of such efforts now remain in the valley. A few citrus, olive, and almond orchards survived the vicissitudes of the times, and these are now producing profitable crops, although frosts in recent years have interfered materially with the extension and success of the citrus industry.

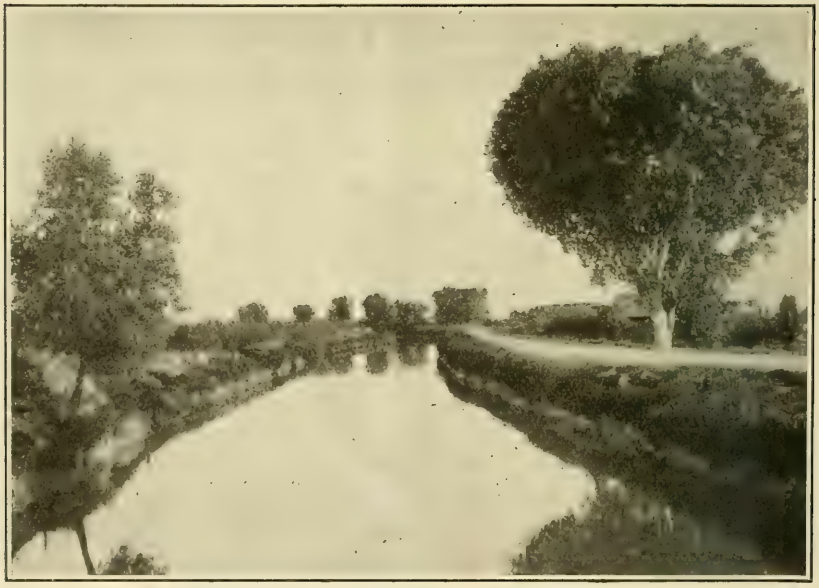

FIG. 2.—The Arizona Canal, Salt River Valley.

An attempt to manage the water supply more successfully was made in 1898, when all the canals on the north side of the river were organized under one corporation, known as the Arizona Water Co. These canals were operated by this company until 1903, when all the canals in the valley, except the Tempe Canal, and perhaps one or two small ditches, were brought under one control by the organization of a corporation known as the Arizona Water User's Association, into whose membership were brought all the water users supplied by these canals. This corporation then entered into contract with the United States Government for the development of water and its delivery to the lands controlled by the association.

A reclamation project for the valley was authorized March 12, 1903, and the construction of the Roosevelt Dam at the junction of

woolly aphis have interfered with the development of apple orchards, while lack of dependable markets has prevented any great development of the stone fruits. On the whole, considerably less fruit is produced in the valley now than formerly.

Until very recently the excellent market for alfalfa hay has prevented any great development of dairying and beef production. One creamery is operated at Safford, but it is not sufficiently well patronized to enable it to operate at its full capacity. A few men feed steers for the market, and a few hogs are raised, but the production and sale of alfalfa hay is by far the most important enterprise carried on. Poultry is an important side line to other enterprises here, as in both the other valleys described.

Transportation is furnished by the Gila Valley, Globe & Northwestern Railroad, which leaves the main line of the Southern Pacific at Bowie and extends to Globe, traversing the entire length of the valley.

METHOD OF INVESTIGATION.

The farmers were visited personally by the investigator, and a complete record of a year's business obtained. To take into account the effect of economic or climatic differences in seasons the investigation was extended over a period of three years, beginning with the year 1913. Complete records were obtained of the business transacted on 162 farms during the year 1913, and similar records were obtained on 378 farms for 1914 and on 185 farms for 1915, making a total of 725 farms studied during the three years. Ninety-eight of these records were either inaccurate or the farms were not considered typical of the districts studied and were eliminated from the general tabulations presented in this bulletin.

The area studied in Salt River Valley extends in a belt 40 miles long from Peoria in the northwest part of the valley to Gilbert in the southwest. At Peoria the belt has a width of 14 miles. It narrows to a width of 2 miles at Tempe, and widens again to 11 miles at Mesa and Gilbert. With few exceptions, every farm in this belt was visited, and studies were made on all typical farms that had been in operation long enough to have established a definite system of farming. The total area of the farms studied in this valley is 59,676 acres, or nearly one-third of the total area cultivated.

In Yuma Valley, studies were made on the farms in the upper end of the valley near Yuma and those in the lower end of the valley surrounding Somerton. In addition to these, all farms within 2 miles of the road connecting these two localities were visited. In this way farms on practically all the soil types of the valley were studied, the majority of them being on the two more common types, the Imperial loam and the Imperial sandy loam. The total area of the farms studied in this valley is 6,486 acres, or a little more than one-fourth of the area under cultivation in 1915.

In the Gila Valley, nearly all the farms between Fairview and the San Simon wash were visited. These farms are in a narrow belt on the south side of the Gila River, which varies in width from 1 to 4 miles and extends up and down the river a distance of 20 miles. The irrigated area in Gila Valley extends several miles farther, both up and down the river, and there are farms on both sides of the river, but it is believed that the belt in which these studies were made contains farms representative of the whole district. The 105 records obtained in this valley represent a total of 8,301 acres, constituting not far from one-third of the total area under cultivation.

The farmers responded heartily to the questions asked, and are to be complimented upon the accuracy of the data furnished. Many of them kept books, which were placed in the hands of the investigator, and from which nearly every item in the record was obtained in exact figures. To the question, "Do you keep farm accounts?" asked of 647 farmers, 179 answered "Yes," and 181 answered that they kept a partial system of accounts. It thus appears that 55.6 per cent of the farmers in the irrigated valleys of southern Arizona keep some form of farm accounts.

Supplementing the more complete systems of accounts, almost every farmer interviewed had some form of pocket memoranda from which he could give many of the items in exact figures. In this manner, and from the sets of books examined, the following items of the data herein presented were obtained in exact figures from practically every farmer interviewed: Receipts from sales of hay, grain, and cotton; thrashing, ginning, and baling charges; taxes, water rent, sales and purchases of live stock, and the amount paid out for steady labor and for cotton picking.

Besides the items wholly or partially estimated, 28.3 per cent of all sales of dairy products above $100 were reported in exact figures either from books or creamery statements. Among those who estimated this item 27 farmers were selected at random, and their estimates compared with the exact figures on the books of the creameries patronized; the average of their estimates was exact to within 1.3 per cent. The increase in numbers of live stock was obtained in exact figures; but the value of live stock gains was estimated. These estimates were checked by comparison with prices obtained for similar live stock at cash sales, and the prices were in very close accord with the estimates given by the farmers. The estimated value placed upon farm machinery was checked by comparisons with prices at several retail machinery stores.

The conclusions that may be drawn from these investigations are therefore based upon data by far the greater portion of which is exact and in which, where estimates have been used, the element of error in each case has been reduced to a minimum.

STANDARDS USED IN THIS BULLETIN FOR MEASURING SUCCESS.

The rate of interest earned on investment is important for our purpose only on farms of large capitalization, where it may be assumed that the most of the operator's time would be required in supervision to make his capital earn current interest rates, whether invested in a farm or loaned on farm mortgages. On the majority of farms, however, the farmer must be both a laborer and a capitalist, and the amount earned for his labor on the farm is frequently of much greater importance than the interest earned on the investment. The amount so earned by the operator's labor is termed the "labor income"[1] of the farm. It is the most important measure of success for the renter, the farmer heavily mortgaged, or the farmer with small capital. It is an important standard of measurement when the farm is viewed from what has been termed the "cold business standpoint," especially if the farm could be sold readily and the money loaned at current interest rates. It then becomes a measure of the value of the investment.

But many farmers do not look upon the farm as an investment. They regard it from the standpoint of a home and the means of independence in earning a living. For them the standard of living afforded by the farm is the most important consideration, and they are chiefly interested in the magnitude of the farm income, which determines this standard.

It will perhaps be conceded that a minimum measure of success in farming would be reasonable wages for the operator's labor, or a farm income sufficiently large to provide the farm family a comfortable living. Both measures will be used in this bulletin, and a brief discussion of how they are obtained is in order at this point.

What constitutes "reasonable" wages for the farmer's time may be determined by comparison with wages paid to farm laborers. The minimum wage for steady farm help, paid in the majority of cases to Mexican laborers, is $35 per month, with room and board. American laborers usually get more, the amount varying up to $75 per month, with room and board, for the best dairy help. Foremen and managers get still higher wages, up to $1,500 per year with house and garden furnished and including the privilege of keeping poultry and at least one cow. The value of the board given to farm help

[1] The labor income is found by subtracting interest on the total investment at current rates from the farm income. It represents the earning power on that farm of the farmer's labor and managerial ability, and may be sometimes referred to in this bulletin as the "farmer's wages." In southern Arizona the current interest rate on farm mortgages is 8 per cent. The labor income has therefore been determined by subtracting 8 per cent on the total investment from the farm income.

The farm income is the net receipts from the year's business. It is found by subtracting the total expenses, except interest on borrowed money, from the total receipts; gains from increased value of live stock and other increase in inventory that may not have been converted into cash being included in receipts and depreciation being included in expenses. If the farmer is out of debt the farm income represents all of his living and total savings except such items of food, fuel, and house rent as may be contributed to the family living by the farm direct. If he is in debt he must pay interest on borrowed money out of the farm income.

was obtained by asking each farmer to estimate the amount paid out per month for materials contributing to the board of such labor and omitting the materials contributed by the farm direct. The estimates varied from $5 to $25 per month for each laborer, the average being $14. This amounts to $168 per year. Studies show that the farm contributes to the family living about $88 per adult unit per year in board and house rent, bringing the total value of these items furnished to the farm laborer up to $256. At $35 per month the money paid him would amount to $420, bringing the total up to $676 per year, when money, board, and house rent are all included. This may be considered the minimum wage for farm help. The maximum wage, excluding foremen, amounts to $1,156, computed in the same manner. Since these studies were made wages have advanced considerably, but there has been a corresponding advance in prices of farm products.

Opinions may vary as to what constitutes a comfortable living for a farm family, and this subject can be discussed only in a general way. Living requirements in southern Arizona are comparatively high. By studies made on the 725 farms visited during this investigation data have been secured that may be considered reasonably accurate on certain items of living requirements, and these data are presented here.

It has just been stated that data obtained upon the cost of boarding hired labor showed an annual expenditure of $168 per adult unit for food materials purchased. The average number of adult units[1] in the family on 476 farms of 80 acres or less upon which data were taken for the purpose of computing living requirements was 3.5, excluding hired help. At the rate of $168 per unit this would require the expenditure of $588 annually per family for the purchase of food materials. In addition to the purchased materials the family would have the food materials contributed directly by the farm, consisting of orchard and garden products, milk, butter, eggs, and meat. All cereal foods are purchased, including flour.

Computations based upon data secured on 476 farms gave an average of $67 as the value of the milk and butter, $113 as the value of the eggs, $48 for all meats, and $32 for all orchard and garden products, making a total of $260 as the value of all food products contributed to the family living and the board of hired labor by the average irrigated farm of 80 acres or less in southern Arizona. There were an average of 3½ adult units in the family and ½ an adult unit of hired labor, making 4 adult units among whom this food was divided. This is an average of $65 per adult unit and amounts to an average of $228 per farm family, which, when added to the $588 in purchased food, brings the total food requirements up to $816.

[1] In finding the adult equivalent of children the average of the equivalents in dietary requirements of children under 16 years of age worked out by Atwater and published in Farmer's Bulletin 142, (p. 35) was used. This average is 0.6 adult units per child. All children 16 years or older were counted as adults.

These computations were made in the following manner: The total meat furnished by the farm was computed by reports from 102 farms, in which the poultry, pork, and other meat products furnished by the farm were itemized. The eggs and dairy products were computed from differences in sales of eggs per hen and in sales of milk products per cow between farms on which the hens and cows were kept for family purposes and those on which hens and cows were kept primarily for commercial purposes. The computations assumed that the family cows and the family hens were equal in quality to the cows and hens in the commercial herds and flocks, an assumption believed to be not far from the fact in southern Arizona. The orchard and garden products were computed from data taken on the farms showing the percentage of farmers having gardens and bearing orchards, making use for this purpose of data collected by Mr. W. C. Funk[1] of this office showing the percentage of vegetables and of fruit in the total food requirements of farm families in 10 different States.[2]

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[1] W. C. Funk, "What the farm contributes directly to the farmer's living," Farmers' Bulletin 635, pp. 9, 12, and 13.

[2] The computations, partially in detail, are as follows:

Dairy products.—Out of a total of 476 farms studied for this purpose 186 kept only family cows, the total number of cows on the 186 farms being 416, or 2.2 cows per farm. These cows supplied the farm table with dairy products, and in addition a surplus of $20 per cow was sold. There were 211 farmers engaged in dairying as a commercial enterprise, who kept a total of 2,924 cows. Assuming that they also required an average of 2.2 cows per farm for family purposes, there would be a total of 464 family cows on these 211 farms, leaving 2,460 cows used strictly for commercial purposes. Assuming further that these family cows also produced a surplus of $20 per cow above table requirements, the total sales from the 464 family cows would amount to $9,280. This sum, subtracted from the total sales on the 211 farms, amounting to $159,338, leaves $150,058 as the value of the total dairy products from 2,460 cows, which is an average of $61 per cow. We have assumed the family cows to be as good as the commercial cows, so that $61 per cow also represents the total value of their products, from which a surplus of $20 per cow was sold, leaving $41 per cow as the value of the dairy products consumed on the farm. Since an average of 2.2 family cows per farm were found, the total value of the dairy products consumed on the farm is in round numbers $90 per farm. Young calves would consume at least $10 of this (the exact figures given by two dairymen keeping over 100 cows each were $5.25 per calf), leaving $80 as the value of the dairy products consumed on the farmer's table on each farm where cows were kept. There were 79 farmers out of the 476 who kept no cows, which brings the average down to $67 per farm for the 476 farms studied.

Eggs.—The value of the eggs used on the farmer's table was computed in the same manner as the dairy products. Of the 476 farms, 370 kept only family flocks of poultry, while 85 made poultry a commercial enterprise. The family flocks averaged 94 hens, from which a surplus of eggs valued at 73 cents per hen was marketed. The total product per hen of the commercial flocks was $2.03, leaving $1.30 per hen as the value of the eggs consumed on the farm, or a total of $122 per farm. The value of the eggs required for hatching was $4 per farm, leaving $118 per farm as the value of the eggs consumed on the farmer's table, on all farms keeping hens. Of the 476 farmers, 21 kept no hens, reducing the average to $113 per farm for the 476 farms studied.

Meats.—The meat contributed to the farmer's table by the farm consists almost entirely of poultry and pork. Of 476 farms studied, 455 kept poultry, and of these 95 reported the value of the poultry consumed on the farm. Computations based on these reports give an average of $25 per farm as the value of the poultry contributed to the farm table on the 476 farms. Of these farms 268 kept hogs, and 59 of these reported the value of the pork contributed by the farm to the farm table, the average being $20. The average value of all other meat contributed to the farm table by the farm is $3 per farm, based on 102 reports. This makes a total of $48 worth of meat contributed to the farm table by the farm, which is the exact average of the 102 farms reporting.

Garden and orchard products.—Out of 532 farms reporting, only 121 had gardens, or 22.7 per cent of the total number. Orchard data were taken on 702 farms and 231 of these or 32.9 per cent, reported bearing orchards. Mr. W. C. Funk has shown that fruit constitutes 6.3 per cent of the total food of the farm families in 10 different States, and that 66.6 per cent of this fruit is furnished by the farms. He has shown that in the same 10 States vegetables constitute 11.5 per cent of the total food of the farm families and that the farm contributes 78.2 per cent of the vegetables consumed. Assuming these figures to hold good in Arizona, and multiplying by the numbers having gardens and orchards, we find that the garden contributes 2.0 per cent of the total food required, and the orchard 1.4 per cent. In round numbers, this amounts to $32 per farm.

Recapitulation.—These calculations, which are reasonably accurate, give $67 in dairy products, $113 in eggs, $48 in meats, and $32 in vegetables and fruit contributed to the family living and board of hired labor by the farm direct.

The value of house rent, which is a direct contribution to the family living by the farm, is determined by the value of the houses found on the farms. The average value of the farm dwelling in all size groups of farms from the smallest farms up to those of 80 acres is nearly the same, and the average for the 476 farms of 80 acres or less is $944. On the larger farms the average value of the farm dwelling is greater than this figure. Houses in southern Arizona rent for about 10 per cent of their value. This gives $94 as the average value of the house rent contributed by the farm on the 476 farms under consideration. These computations are summarized in Table V.

TABLE V.—*Average contribution of the farm to the living of the family and board of hired labor on 476 irrigated farms in southern Arizona.*

Items.	Value.	Items.	Value.
Eggs	$113	House rent	$94
Dairy products	67		
Meat	48	Total	$354
Fruit and vegetables	32		

Including hired labor, there were on an average 4 adult units on these farms, making the contributions of the farm $88.50 per person. The farm family averaged the equivalent of 3.5 adult units, which makes its share of the living obtained from the farm in round numbers $310. Adding this to the $588 of purchased food gives a living requirement of $898 for food and house rent. This leaves other items of living expenses such as fuel, clothing, doctor bills, newspapers and periodicals, church and benevolent contributions, recreations and amusements, books, life insurance, and household furnishings unprovided for. We have no data on these items for Arizona, but if they should be estimated at $400, a very conservative estimate, we have in round numbers $1,300 as the living requirement of an average farm family in the irrigated valleys of southern Arizona, of which the farm contributes $310 and the balance of $890 must be purchased out of the farm income and the earnings of any members of the farm family other than the operator, either upon the farm or off, the value of such labor on the farm having been charged against it as an expense in determining the farm income. This estimate does not provide for the payment of any interest on borrowed money, nor does it provide for the payment of the construction charges on the irrigation projects in Salt River and Yuma Valleys. Considering the fact that these charges will not be less than $2.80 per acre annually for a period of 20 years in Salt River Valley, and considerably more than this amount for the same period of time in Yuma Valley, it appears from the foregoing figures that a farm income of $1,000 above the food and house rent obtained from

the farm direct would fall considerably short of furnishing a comfortable living and the education of the children to an average farm family on the irrigated farms in southern Arizona, even if the family were out of debt; and the shortage would be much greater if the family were obliged to borrow much of the money required for the purchase and development of the farm.

TYPES OF FARMING.

With the exception of a few small fruit and poultry farms, alfalfa is the basis of all farming in the irrigated valleys of southern Arizona. There are always a few hundred acres of experimental crops in this region, for Arizona farmers have long been awake to the limitations of alfalfa farming, and a few thousand acres of grain crops are grown, the grain crops being used as a means of rotating the alfalfa fields and for growth upon land not sufficiently well supplied with water to make the alfalfa crop a reliable one; but in the main a thrifty alfalfa field taking in most of the farm has been the ultimate goal of by far the greater number of farmers who have settled in these districts.

On 627 farms, the records of which were used in the study of type, there were 39,803 acres in alfalfa, out of a total crop acreage of 59,932. This is 66.4 per cent of the total crop acreage, and this percentage holds good for farms of all sizes except those smaller than 20 acres; and even in this group of small farms over 50 per cent of the total crop acreage is in alfalfa.

The type problem, then, for Arizona farmers has been largely to find the most profitable form in which to market the alfalfa crop. Efforts in this direction have resulted in the following types of farming: Hay farming, sale of pasture, production of alfalfa seed, dairy farming, fattening beef cattle, diversified farming,[1] and production of miscellaneous types of live stock. These will be discussed in the order named. In considering the tables herein presented, however, it should be remembered that it is unsafe to draw conclusions from averages where only a small number of farms appear in any group, and that in general the larger the number of farms appearing in a group the more reliable are the conclusions to be drawn from average results.

HAY FARMING.

Of 627 farms 85 were engaged chiefly in the production and sale of alfalfa hay, obtaining an average of 69.7 per cent of their total receipts from this source, while 40 more combined the sale of hay with some other enterprise, giving such enterprise about equal

[1] All farms are classified as diversified when the interest of the operator has been about equally distributed among three or more enterprises.

prominence, and obtaining over 80 per cent of their total receipts from the two enterprises. Of these, 37 combined hay farming with either grain farming or dairying, 1 combined it with the production of beef cattle, and 2 combined it with poultry raising. Hay farming is found on farms of all sizes, though the medium and larger-sized farms (see fig. 5) are better adapted to the enterprise than the smaller

FIG. 5.—An alfalfa hay farm—cutting the first crop of the season.

farms, as will be shown in tables presented farther on. The average results obtained in hay farming and its various combinations are shown in Table VI:

TABLE VI.—*Results obtained in hay farming in the irrigated valleys of southern Arizona, 1913 to 1915.*

Type of farming and percentage of receipts from leading enterprises.	Number of farms.	Average area.	Total receipts.	Farm income.	Labor income.	Number failing to make 8 per cent on investment.
		Acres.				
Hay, 69.7	85	100	$3,742	$2,110	$420	29
Hay, 43.7 Grain, 36.4	19	96.7	3,212	1,803	143	8
Hay, 40.5 Dairy, 41.1	18	63.0	2,792	1,709	556	6

Success in hay farming is greatly influenced by both price and yield. The effect of increasing yield per acre with price remaining nearly constant is shown in Table VII:

TABLE VII.—*Effect of increasing yield per acre on success in hay farming.*

Yield.	Number of farms.	Average yield.	Average price.	Average area.	Number failing to make 8 per cent on investment.	Average receipts.	Average farm income.	Average labor income.
Tons per acre.				*Acres.*				
4.5 and under	17	3.7	$7.70	113	14	$2,606	$1,318	—$312
4.6 to 5.5	22	5.1	8.70	119	7	3,851	1,981	101
5.6 to 6.5	17	6.0	8.30	134	5	5,167	2,804	464
6.6 to 7.5	21	7.0	9.00	95	4	3,779	2,202	524
Over 7.5	22	9.0	9.10	61	3	3,478	2,321	1,037

The price of the product also has a great influence on success in hay farming. Before the considerable expansion of the area in alfalfa in Arizona due to increased water supply, and while the Reclamation

FIG. 6.—Curing alfalfa hay in cocks—Salt River Valley.

Service was actively engaged in operations requiring a large amount of team work, the demand for alfalfa hay was strong and prices were comparatively high, but about the close of the year 1913 prices dropped to low figures and remained low through 1914 and 1915. The market was again stimulated in 1916 by the presence of United States troops on the Mexican border and prices rose to an abnormally high figure. Comparatively high prices were obtained late in the season of 1915 and early in the season of 1913, so that a considerable range in price is represented in the records used for this study. The price is also affected by the manner of curing and handling the hay, those farmers who cure in cocks (see fig. 6) and handle with pitch

forks receiving higher prices than those who cure in the windrow and handle with the buck rake. Better prices are also obtained by those farmers who protect their hay during storage by the use of hay barns—and they also have a smaller percentage of damaged hay.

The effect of increasing price on success in hay farming, with yields remaining nearly constant, is shown in Table VIII.

TABLE VIII.—*Effect of increasing price per ton on success in hay farming in southern Arizona.*

Price per ton.	Number of farms.	Average price per ton.	Average yield per acre.	Average area.	Number failing to make 8 per cent.	Average receipts.	Average farm income.	Average labor income.
			Tons.	*Acres.*				
$6.90 and under	15	$6.00	5.3	92	8	$2,759	$1,548	—$23
$7 to $7.90	13	7.40	5.9	162	6	5,148	2,580	327
$8 to $8.90	29	8.40	6.0	90	12	3,413	1,847	242
$9 to $9.90	17	9.20	7.1	75	5	2,920	1,763	292
$10 and over	25	10.70	6.9	101	1	4,542	2,761	944

When allowance is made for difference in size of farm, it is seen that both labor income and farm income increase steadily as the price rises from an average of $6 per ton to an average of $10.70 per ton, but satisfactory results from the standpoint of labor income are not obtained until the price is above $10 per ton. It also appears from both this table and table VII that high yields and high prices tend somewhat to go together. This is due to the fact that the farmers who take the best care of their fields also use methods which produce a higher quality of hay, and a greater percentage of them hold their hay for higher prices. The last line in Table VII indicates that satisfactory results are not obtained until both yield and price approach their maximum.

These tables, showing the effect of price and yield on the farm income and labor income, tend toward the general conclusion that with economic conditions as they were during the three years 1913, 1914, and 1915, hay farming is highly profitable only with both maximum yields and maximum prices. Hay farming was less profitable than dairying, the feeding of beef cattle, or the production of alfalfa seed, and was less profitable than cotton farming when the price of cotton was 20 cents per pound, as will be shown in tables to be presented farther on. As the percentage of total receipts derived from hay rose there was a general decrease in both farm income and labor income up to the point where the receipts from hay constituted from 45 per cent to 65 per cent of the total receipts. This indicates that hay farmers were not generally successful in trying to combine some other enterprise with the production of hay for the market. But while those farmers who devoted all their attention to hay farming were more successful than those who tried to combine it with some enterprise other than cattle, they were still much less

successful as a general proposition than those farmers who sold little or no hay. The effect of increasing percentage receipts from hay on farm income and labor income is shown in Table IX:

TABLE IX.—*Depressing effect on farm income and labor income of increasing percentage of receipts from sales of hay, 1913 to 1915.*

Per cent of receipts from hay.	Number of farms.	Average percentage receipts from hay.	Average area.	Number failing to make 8 per cent.	Average receipts.	Average farm income.	Average labor income.
			Acres.				
0 to 5	327	0.6	119	66	$5,157	$3,104	$1,079
5.1 to 25	128	12.3	112	36	4,335	2,691	734
25.1 to 45	74	33.9	78	24	2,985	1,800	470
45.1 to 65	44	53.4	100	15	3,480	1,913	18
65.1 to 100	56	77.6	105	20	3,931	2,222	476

SALE OF PASTURE.

The sale of pasture is an important side line on nearly all hay farms, especially those in Salt River and Yuma Valleys. A considerable crop of "aftermath" which grows after the last cutting of hay in the season is usually marketed in the form of pasture. On the heavier soils irrigation during the hottest part of midsummer causes a growth of wild grasses known as "water grass" to spring up in the fields, which distinctly checks the growth of the alfalfa. The midsummer crop is also injured more or less by worms produced by a common butterfly. For these reasons it is often more profitable to market this crop as pasture than to cut it for hay. More or less hay is always damaged by the local showers of the midsummer rainy season, and by feeding this hay to cattle along with green forage it often may be marketed when otherwise there would be no demand for it.

The pasture is paid for by the cattle feeders at a stated price per head per month. The price varies from being occasionally as low as $1 per head per month to $2.50 per month. The higher prices prevail during the winter season, when usually some second class hay is fed along with the pasture. Of the farms studied there were but 13 upon which the sale of pasture was of sufficient importance to make it a leading enterprise. Their average size was 150 acres, and the average receipts, farm income, and labor income were $3,673, $2,454, and $417 respectively. These results are slightly lower than those obtained when the sale of hay was a leading enterprise.

ALFALFA SEED.

The production of alfalfa seed for the market is a leading enterprise in Yuma Valley and in what is known as the "Buckeye" country, an isolated strip of irrigated land on the Gila River below Salt River Valley, having the town of Buckeye at its center. The enterprise is

of little importance in Salt River Valley or in Gila Valley, the yields in these districts being unsatisfactory. Either one or two crops per year may be produced, according to the inclination of the grower. In Yuma Valley, where all the alfalfa-seed farms studied for this bulletin were found, the yields are usually highly satisfactory, the average for the farms studied being 285 pounds per acre; and as much as 1,300 pounds of salable seed per acre from two crops in a single season has been reported on one farm. It is the most profitable enterprise found in this valley, constituted the principal source of receipts on 12 of the farms studied, and was an important side line on many others. The 12 farms averaged 71 acres in size, and the average results obtained were as follows: Receipts, $3,750; farm income, $2,479; labor income, $1,273. The sale of hay was made an important secondary enterprise on these 12 farms, the average receipts from hay being 22.9 per cent of the total receipts, while alfalfa seed furnished an average of 58.6 per cent of the total.

DAIRY FARMING.

Dairy farming is a well-established enterprise, and is steadily growing in importance. The mild winter climate, the long growing season, and the abundance of green forage due to the thrifty alfalfa plant, all combine to make southern Arizona a congenial home for the dairy cow. The farmers are coming more and more to realize the stability of the dairy enterprise, and at the present time there are more than twice as many men making dairying a leading enterprise as can be found engaged in its nearest competitor, hay farming.

Of 627 farms studied, dairying was a leading enterprise on 178, contributing an average of 67.7 per cent of the total receipts. Upon 38 farms dairying was combined with some other enterprise, the two enterprises contributing more than 80 per cent of the total receipts. In addition to these 216 farms upon which dairying was the most important enterprise, there were 109 diversified farms upon which dairying contributed an average of 22.3 per cent of the total receipts, a larger amount than was contributed by any other one of the various enterprises found on these farms. The general results obtained in dairy farming are presented in Table X:

TABLE X.—*Results obtained in dairy farming in the irrigated valleys of southern Arizona, 1913 to 1915.*

Type of farming and percentage of receipts and leading enterprises.	Number of farms.	Average area.	Number failing to make 8 per cent.	Average Total receipts.	Average farm income.	Average labor income.
		Acres.				
Dairy, 67.7 Poultry, 7.5	178	83	22	$3,859	$2,600	$1,081
Dairy, 49.3 Poultry, 36.8	9	21	5	1,366	1,012	173
Dairy, 41.1 Hay, 40.5	18	63	6	2,792	1,709	556

Success in dairy farming is greatly influenced by the productivity of the farms and by the quality of the live stock carried. The productivity may be measured in terms of productive animal units [1] carried per 100 acres of land, making due allowance for the amount of feed purchased.

The following tabulation of dairy farms will show the steady increase in receipts, farm income, and labor income, with the increasing number of productive-animal units carried per 100 acres of land:

TABLE XI.—*Effect of increased productivity of land on success in dairy farming in the irrigated valleys of southern Arizona, measured in terms of productive-animal units carried per 100 acres of land.*

Productive-animal units per 100 acres.	Average number productive animal units per 100 acres.	Number of farms.	Average area.	Number failing to make 8 per cent.	Value of feed purchased.	Average Total receipts.	Average farm income.	Average labor income.
			Acres.					
30 and under	26.1	11	108	5	$61	$4,004	$2,629	$795
30.1 to 60	48.0	67	87	17	62	3,409	2,277	773
60.1 to 90	72.4	72	79	5	101	3,900	2,678	1,201
Over 90	128.7	39	57	3	188	4,057	2,578	1,180

The average contribution of animals to the receipts on all of these farms was 86.3 per cent of the total, while crops contributed an average of only 12.1 per cent. It may fairly be assumed, then, that the increased income was due to larger numbers of animals. While more feed is purchased on the farms carrying the largest number of animal units per 100 acres, the amount purchased is not large on any of the farms; and it may safely be assumed that the increased number of animal units is due to increased productivity of the alfalfa fields; also, that this increased productivity has resulted in greater total receipts as well as a larger farm income and labor income. The average number of dairy animal units per 100 acres carried on these four classes of farms was 19, 35, 53, and 91, respectively.

Dairy cows are fed practically the entire year on green forage consisting chiefly of alfalfa pasture (see fig. 7). Increasing productivity resolves itself, therefore, into the problem of increasing the carrying capacity of the alfalfa fields. It has been found that steady pasturing of a single field throughout the year greatly reduces its carrying capacity. The plants are eaten so close to the ground that they fail to produce the shade necessary to prevent the rapid growth of water grasses, bermuda grass, and noxious weeds that soon crowd

[1] An animal unit is the equivalent of a full-grown horse, steer, or cow. Equivalents in other animals are determined by food requirements, and in this bulletin 2 calves, heifers, or colts, 7 sheep, 5 hogs, 10 pigs, 100 chickens, or 50 turkeys are, respectively, regarded as representing food requirements equivalent to those of a full-grown horse, steer, or cow, and are therefore counted as one animal unit. Productive animals are those that contribute directly to the farm receipts. Work horses are not considered among productive animals, because they do not contribute directly to farm receipts. All other animals are considered productive.

FIG 7.—Dairy cows on alfalfa pasture.

out the alfalfa plants. Close cropping also prevents sufficient nourishment reaching the roots to insure strong healthy plants, while, when the ground is wet from irrigation or rains, tramping incident to continuous pasturing tends further toward root starvation by limiting air circulation and interfering with the penetration of moisture.

The more successful dairymen are adopting a system of rotation pasturing (see fig. 8) described by the writer in Circular No. 54, United

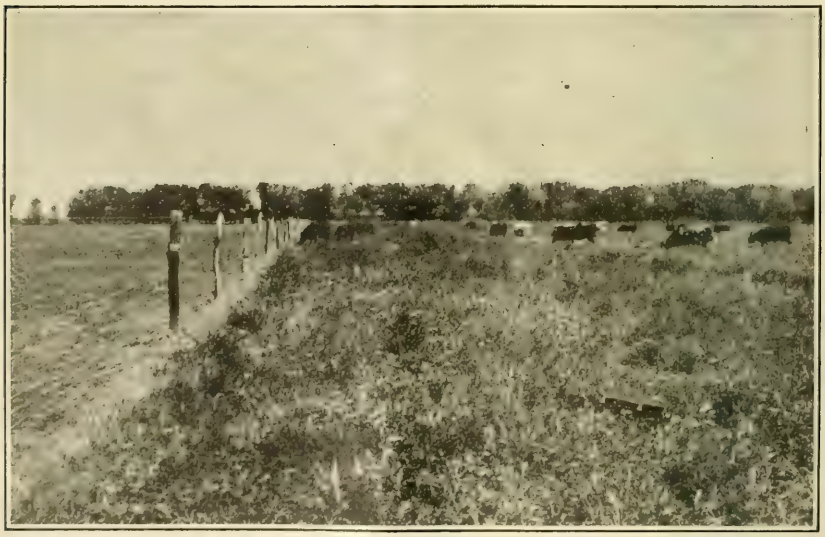

FIG. 8.—Rotation pasturing on a dairy farm. On the right an alfalfa crop being harvested by dairy cows—54 head on 20 acres. On the left an alfalfa field from which a crop of alfalfa has just been harvested by dairy cows.

States Department of Agriculture. A concrete example of the operation of the system given in the circular may profitably be referred to again at this point.

A dairy farm of 160 acres all in alfalfa is divided into fields of 20 acres each. Four of these fields are pastured with milch cows during the summer months and the other four are cut for hay. In pasturing, the animals are kept off the fields until the alfalfa is nearly or quite mature enough to cut for hay, and then turned into the fields in sufficient numbers to harvest the crop quickly. From 80 to 90 cows are pastured on a field of 20 acres until the best of the crop has been eaten, and then are turned into another 20-acre field. By varying the time at which cattle are first turned on in the spring, the fields are so managed that crops mature in different fields at different times, thus allowing the cattle to be rotated from one field to another throughout the season. When the best of the crop has been taken by milch cows, they are followed for a few days by dry cows and young dairy stock to clean up such feed as may have been left. Then the field is irrigated and all stock kept off until another crop is ready to be harvested. By discontinuing winter pasturing of hay fields at different dates they are also managed so that crops mature in different fields at different times, and when the hay is harvested it is put up with a hay loader. Dry cows and young stock are allowed to follow the hay loader, thus cleaning up any waste hay. The fields are then watered, and all stock kept off till another crop is ready for harvesting. Dry cows and young stock are fed hay when there is not sufficient pasture for them. At the close of the haying season the fields are seeded [1] to barley, which affords green forage for winter pasture, the fields being rotated as in the summer. Milch cows are allowed free access to hay, and consume considerable quantities of it even when on the best of pasture.

The fields are never pastured when the ground is wet, and a good stand of alfalfa is preserved, the particular farm under consideration having good fields that have not been reseeded during a period of 12 years. Keeping hay before milch cows when on pasture reduces losses from bloat, as does pasturing of only the mature crop. One dairyman with over 100 cows reported that by rotation pasturing and the feeding of hay at all times during the year he had completely eliminated losses from bloat, not having lost a single animal in the last 13 years.

By rotation pasturing the plants are allowed to come to complete maturity, which greatly increases the total yield. Experiments have shown that when alfalfa plants are allowed to come to complete ma-

[1] The barley is seeded in the alfalfa without plowing or disturbing the alfalfa plants in any way. In fact, the harrowing or drilling necessary to cover the barley seed answers for a cultivation of the alfalfa field, loosening up ground that may have become somewhat packed from tramping, thus proving a benefit to the alfalfa.

turity before harvesting the total yield is much greater than when they are clipped off every two or three days.[1] As an example of the results to be obtained by rotation pasturing, it may be stated that one man without purchasing any feed kept on 160 acres of alfalfa 98 dairy cows and enough other live stock to bring the number of his total animal units up to 199. Another pastured 149 mature animals 12 months on 90 acres. Another kept 141 animal units one year on 140 acres of alfalfa, and in addition sold 60 tons of hay and 10,000 pounds of alfalfa seed.

Good dairy stock adds materially to success in dairy farming. The following tabulation, based upon dairy income per dairy animal unit, clearly brings out this fact.

TABLE XII.—*Effect of quality in dairy live stock upon success in dairy farming in the irrigated valleys of southern Arizona.*

Dairy income per dairy animal unit.	Average dairy income per dairy animal unit.	Number of farms.	Average area	Number failing to make 8 per cent.	Dairy products per cow.	Average total receipts.	Average farm income.	Average labor income.	Average price of cows.
			Acres.						
$55 and under	$47	36	72	9	$38	$2,886	$1,709	$357	$90
$55.1 to $65	60	50	92	10	50	3,790	2,405	826	92
$65.1 to $80	72	45	83	5	58	3,855	2,818	1,207	100
$80.1 to $100	89	32	76	4	72	3,290	2,380	1,041	103
Over $100 [a]	124	29	65	3	110	4,802	3,249	1,745	105

[a] Some of the farmers in this group retailed their milk.

The table shows a steady increase in profits accompanying the increase in dairy income per dairy animal unit. The dairy income per dairy animal unit includes the value of all calves and the increases in value of all dairy live stock, as well as the value of dairy products sold. The value of the dairy products sold per cow increases with the income per dairy animal unit. The value of the cows also increases as the amount received for their products increases, showing that the dairymen in Arizona appreciate quality in their dairy animals. It should perhaps be mentioned that in the last group of farms in Table XII a higher efficiency in marketing has added its influence to good quality in the cows, since all the retail dairy farms studied are in this group; but the first four groups of farms are sufficient to bring out forcibly the effect of good quality in dairy stock upon profits in dairy farming.

Several of the leading dairy breeds are found in southern Arizona, but the Holstein breed leads all others in numbers and is represented by several prosperous breeders of pure blood stock. None of these is included in the farms studied, because such farms are regarded as

[1] Lyman J. Briggs and H. L. Shantz. The effect of Frequent Cutting on the Water Requirements of Alfalfa and its Bearing on Pasturage. Bull. No. 228, U. S. Department of Agriculture.

being in a class by themselves and not comparable with ordinary farms. Other dairy breeds are represented by breeders in the valleys, but the numbers of such live stock are far below those of the Holstein breed. Shorthorn cattle, with a preference for the dairy type, rank next in popularity to the Holsteins. These two breeds are preferred because their steer calves develop rapidly on alfalfa forage and purchasers of fat cattle in Arizona make no discrimination against them, contrary to the custom with most dairy breeds. Owners of shorthorn cows are at present breeding them to Holstein bulls, indicating a strong preference in southern Arizona for the black and white dairy cattle. In Salt River Valley, especially, there are a large number of fine graded Holstein dairy live stock, and such cities as Tucson, Bisbee, Douglas, and El Paso are turning to this valley for their supply of dairy cows. Prices of such cattle are no higher in Arizona than in eastern dairy States, and with a little attention to advertising and a little more care in breeding Salt River Valley should soon be known as a home of good dairy live stock and attract buyers from the outside. An outlet would thus be found for young dairy cattle when the present expansion of the dairy enterprise has reached its limits.

The importance of the dairy enterprise in the farm organization may be indicated by classifying all farms studied in the order of increasing percentage of receipts from dairying. Such a classification is presented in Table XIII.

TABLE XIII.—*Effect of increasing percentage of receipts from dairying upon success in farming in the irrigated valleys of southern Arizona 1913 to 1915.*

Percentage receipts from dairying.	Average per cent receipts from dairying.	Number of farms.	Average area.	Number failing to make 8 per cent.	Average total receipts.	Average farm income.	Average labor income.
			Acres.				
0 to 5	1.4	195	141	60	$5,508	$2,768	$618
5.1 to 25	13.2	145	102	45	3,633	2,316	596
25.1 to 45	34.2	94	85	22	3,453	2,182	13
45.1 to 65	54.1	97	79	18	3,423	2,300	45
Over 65	79.6	96	73	16	3,688	2,450	993

Out of receipts totaling $2,913,877, dairy cattle and dairy products contributed $724,740, or 24.9 per cent. The sales of dairy cattle were $266,543 and the purchases $190,240, leaving net sales of $76,303. This indicates large buying and selling locally, and also indicates that when dairying has reached the limit of its possible expansion dairy cattle will have to find an outlet beyond the districts in which they are produced or will have to be sold for beef. The latter alternative will lower prices considerably and make the enterprise less profitable. However, the present large type of dairy cows being produced can easily be sold at from $65 to $75 each for

beef, and unbred heifers will bring as much or more at the age of 3 years when fattened for beef. Prices placed upon dairy live stock were about as follows: High grade heifers ranging in age from 6 months to 1 year, $40; "springer" heifers, $65 to $75; full-grown cows, $80 to $150, the average being about $100, as shown in Table XIII.

The average price paid for butter fat by the creameries was 25.47 cents a pound, and 30 cents was offered where the farmer would agree to deliver his milk or cream sweet. At these prices for butter fat and for dairy live stock, dairying, under conditions similar to those prevailing in 1913, 1914, and 1915, appears to have been the most stable farm enterprise in southern Arizona, as well as one of the most profitable.

The amount of expansion the dairy enterprise will stand and still remain profitable can not be stated definitely. The opinion of three leading creamery men was that the present output of dairy products may be doubled without unfavorable effect on present markets, and that other markets can be developed. The limit in the amount of irrigated land in these valleys will not allow an expansion much greater than this and still retain other profitable enterprises. It appears, then, that success in expansion will depend more upon the market for young dairy heifers after the limits of expansion have been reached than upon new markets for dairy products, unless changes should take place that would limit the present market for these products or lower the price paid for them.

The dairy enterprise has some drawbacks such as losses from bloat, contagious abortion, contagious scours, calf pneumonia, and garget, the latter disease being present in a malignant form, seemingly promoted by the extreme heat of the summer months. It is also difficult to deliver cream sweet without using a considerable amount of ice during the summer months. Contagious scours is being controlled by sanitation, calf pneumonia by vaccination, bloat by rotation pasturing and feeding hay with pasture, and the other diseases will no doubt yield to good sanitary methods and care in breeding.

BEEF CATTLE.

Fattening beef cattle for the market has long been a favorite enterprise on the larger farms in southern Arizona. Contrary to the prevailing custom in the Eastern States, the cattle are not fed grain, but are fattened on green alfalfa forage (see fig. 9) and hay, and the feeding period may vary from 8 to 16 months in length, depending on the size and age of the steers when purchased. The abundance of green forage throughout nearly the entire year, the proximity of the ranges, and the large number of high-grade native steers furnished by the dairymen of the valleys are factors favorable to the

enterprise. Fluctuating prices of both range steers and fat cattle introduce a greater element of speculation than is found in the dairy enterprise, and the capital required is greater; but on the whole the enterprise compares very favorably with dairying. Thirty farmers out of the 627 interviewed for these studies made the fattening of beef cattle a leading enterprise, obtaining on the average 61.5 per cent

FIG. 9.—Fattening steers on alfalfa pasture.

of their total receipts from this source; and 10 others combined the beef-cattle enterprise with some other enterprise in about equal proportions, obtaining over 80 per cent of their total receipts from the two enterprises. Results that were obtained in beef-cattle farming are shown in Table XIV.

TABLE XIV.—*Results obtained in beef cattle farming in the irrigated valleys of southern Arizona, 1913–1915.*

Type of farming and percentage of receipts from principal enterprises.	Number of farms.	Average area.	Number failing to make 8 per cent.	Average receipts.	Average farm income.	Average labor income.
		Acres.				
Beef cattle, 61.5; Crops, 17.6	30	298	6	$11,101	$7,155	$2,146
Beef cattle, 41.7; Grain, 34.2	5	370	1	12,211	5,295	1,505

HOG FARMING.

Six farmers out of 627 made hog raising a major enterprise, obtaining an average of 50.6 per cent of their total receipts from this source. There were only 31 farms upon which hogs furnished as much as 25 per cent of the total receipts. The results of investigations thus far are not favorable to hogs as a major enterprise, both labor income and farm income on hog farms being greatly below the averages for all farms of similar size. The enterprise has been

expanding during recent years, on account of the general tendency of Arizona farmers to substitute live-stock farming for hay and grain farming. The market seems to be quite local in character, and a very marked depreciation in price followed a marked increase in the number of hogs kept on the farms in 1915. Where large quantities of grain are fed to hogs the farm income and labor income are both uniformly low. Poor results are also obtained where large numbers of hogs are kept on the same farm. The best results have thus far been obtained where hogs are kept as a minor enterprise in combination with dairying or grain farming, the hogs getting most of their subsistence on alfalfa pasture and being fattened only a short time on waste grain or skim milk. It is conceded that the quality of pork produced on skim milk is not equal to that produced on barley, but the fact remains that most of the profit is taken out of the hog enterprise when grain constitutes the chief article of feed for any considerable time.

HORSES.

Raising horses for the market is incidental to the keeping of necessary work stock; of 627 farms only 3 were found upon which the marketing of horses assumed a magnitude approaching a major enterprise. These farms are classified as diversified farms, since several other enterprises also found upon them were of equal importance to horses. Growing colts contribute more or less to the receipts upon a large number of the farms, but the amount of such receipts is of minor importance, except in a few cases upon diversified farms.

SHEEP.

Sheep raising in the irrigated valleys of southern Arizona is of minor importance, only 3 farms being found where sheep assumed the magnitude of a major enterprise, and 2 of these combined sheep with some other enterprise. The use of sheep for ditch-cleaning purposes is advantageous, and for this purpose a small flock of sheep may well be kept on nearly every farm, but in general at this time sheep raising on a large scale is not profitable. The 3 farms upon which sheep raising was the chief source of receipts averaged 231 acres in size and obtained from sheep an average of 43.6 per cent of their total receipts. The average results were: Receipts, $7,637; farm income, $3,793; labor income, minus $337. That is to say, the average farm business lacked $337 of paying expenses and interest on investment.

DIVERSIFIED FARMING.

All farms have been classified as diversified upon which the interests of the operator have been about equally distributed among 3 or more enterprises, taking into account receipts, acreage, and capital

invested, and the 3 or more leading enterprises contributing at least 60 per cent of the total receipts. Nearly all of these farms have but 3 leading enterprises. A few have 4 and a very small number have as many as 5. Alfalfa is the basis of their system; the sale of hay contributes more than 15 per cent of the total receipts on 59 out of 109 diversified farms, while pasture and alfalfa seed contribute more than 15 per cent of the receipts on 9 more of the farms in this class. Dairying contributes more than 15 per cent of the total receipts on 62 of the farms, and poultry on 35. The average percentage of receipts contributed by these 3 enterprises on the 109 farms is as follows: Dairying, 22.3 per cent; alfalfa hay, seed, and pasture, 20.5 per cent; poultry, 11.9 per cent. Grain contributes more than 15 per cent of the receipts on 33 farms, hogs on 15 farms, cotton on 16 farms, horses on 14 farms, cantaloupes on 9 farms, fruit on 9 farms, truck on 4 farms, beef cattle on 8 farms, and bees on 7 farms.

Grain contributes an average of 9.9 per cent of the total receipts on the 109 farms, hogs, 7.5 per cent; horses, 5.3 per cent; cotton, 4.5 per cent; beef cattle, 4.3 per cent, and fruit, 4.2 per cent.

Haying occurred combined with poultry and some other enterprise on 22 farms, with dairying and some other enterprise on 24 farms, with beef cattle and some other enterprise on 7 farms and with various other enterprises on 8 farms. Poultry occurred combined with dairying and some other enterprise on 42 farms, and dairying occurred combined with poultry on 42 farms, with hay on 24 farms and with various other enterprises on 5 farms, making out of 109 diversified farms a total of 71 upon which dairying was a prominent enterprise.

The average size of the 109 farms is 88 acres, and the average results obtained were: Receipts, $3,362; farm income, $1,985; labor income, $515. These results are far below those obtained on 178 farms, averaging 83 acres, where dairying was the chief source of receipts, contributing 67.7 per cent of the total. (See Table XI.)

POULTRY.

Records were obtained on 32 farms upon which poultry furnished the greater part of the farm receipts, but since many of the operators were engaged in outside enterprises not connected with the farm, only 21 of the records were used for this study. These 21 farms averaged 27 acres in size and obtained 71.7 per cent of their total receipts from poultry. In addition, two farmers combined poultry with hay and two with fruit, each making poultry dominant over the other enterprise. While poultry is a favorite enterprise on the small farms (see fig. 10) it is by no means confined to them, being a minor enterprise of considerable importance on nearly all farms and frequently assuming considerable magnitude on the larger farms, receipts of over $2,500 from poultry having been found on one farm in each of the groups averaging 80 acres, 100 acres, 160 acres, and 530 acres. It has

already been shown to be one of the three leading enterprises on 42 diversified farms.

Chickens and turkeys are the kinds of poultry almost universally raised, the chickens for the eggs produced and the turkeys for the market. The climate is adapted to egg production and the average production per hen is large, the average value of the eggs produced on 476 farms being $2.03 per hen.

A flock of from 50 to 100 turkeys usually adds a nice sum to the total receipts, and since when allowed to roam the alfalfa fields at will they require little grain to prepare them for the market, their addition to the receipts is nearly all profit. Twenty-one poultry farms averaging 27 acres in size made an average farm income of $1,044. The average labor income was $409.

GRAIN FARMING.

Grain farming (see fig. 11) affords a ready means of rotation for run-down alfalfa fields, and is extensively used for this purpose.

FIG. 10.—A poultry farm of 10 acres—Salt River Valley.

Grain is also grown on newer lands, and by renters on cheaper lands whose owners live elsewhere and hold the lands for speculative purposes. It is a favorite crop on lands that secure most of their water during flood times, as the flood waters are available at seasons more suited to grain culture than any other crop. It is also a favorite crop with the possessors of school lands, who have not wished to make too extensive improvements of their lands until after they learn upon just what terms they are to be allowed to come into permanent possession of them. Because of the cheaper lands upon which the grain crops are grown, involving a lower interest charge against the farm income, grain farms show a relatively higher labor income than would otherwise be the case.

Wheat, barley, and the grain sorghums are the leading grain crops. Oats and corn are of minor importance, though they are included in considering all receipts from grain. Milo maize, feterita, and kafir corn are the favorite grain sorghums.

When the alfalfa fields have ceased to be profitable they are plowed up and seeded to wheat or barley during the fall or winter months. The grain is harvested during the following May or early June. If the field is to be seeded to grain a second time, the land is irrigated and the stubble and volunteer young grain pastured during the remainder of the summer, or the field may be seeded to one of the grain sorghums, the lister being used for this purpose and only one or two cultivations being given to the growing crop. When the second crop of barley or wheat is sown the land is at the same time reseeded to alfalfa. This is the nearest approach to a system of rotation in vogue in Arizona, and it is by no means a general practice.

Opinions differ as to the value of the practice of seeding a grain sorghum crop during the summer upon the fields to be later seeded to

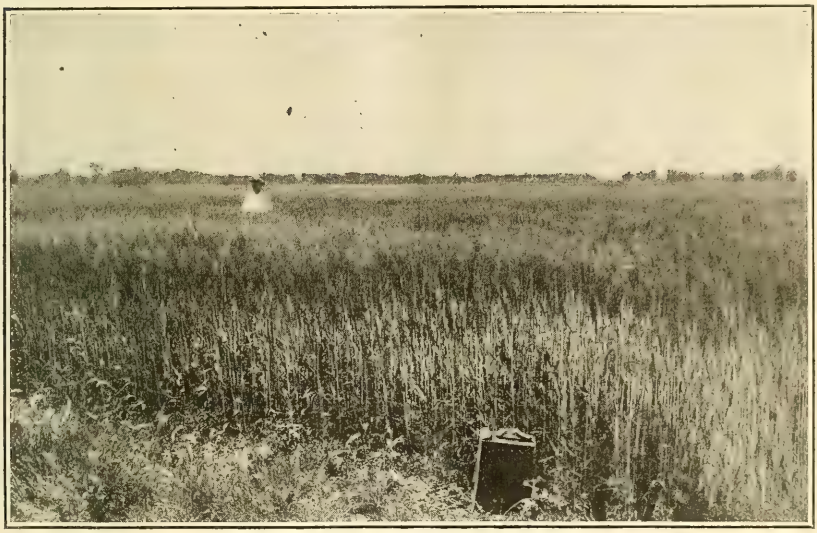

FIG. 11.—A thrifty grain field in Salt River Valley.

wheat or barley. Some claim that the grain sorghum crop injures the land and reduces the yield of the succeeding crop of wheat or barley. Some landlords stipulate in their rental contracts that grain sorghums shall not be seeded during the summer months upon wheat or barley lands. Results obtained by the two systems of cropping are shown in Table XV.

TABLE XV.—*Effect of double cropping on success in grain farming in the irrigated valleys of southern Arizona, 1913–1915.*

System of cropping.	Number of farms.	Average area.	Yield per acre.			Receipts.	Farm income.	Labor income.
			Wheat.	Barley.	Grain sorghums.			
		Acres.	*Pounds.*	*Pounds.*	*Pounds.*			
Double-cropped	18	246	1,667	1,828	2,236	$6,239	$3,097	$839
Not double-cropped	27	159	2,082	1,863	2,034	4,316	2,389	280

The table shows very little in favor of either system over the other. Considering the larger size of the farms the farm income in the group of farms upon which double cropping is practiced is about as much larger than that of the other group as could be expected from the influence of the factor of size alone. The labor income is proportionally larger, but this is due largely to the cheaper lands upon which double cropping was practiced. None of the farmers whose farms are listed in the double-cropped group treated as much as 100 per cent of their grain lands in this manner, and some did not double crop more than 20 per cent of them. For a single season the income from grain farming is much greater when double cropping is practiced than where only a single crop is grown, and there is no evidence that the grain sorghum interferes with the growth of the succeeding alfalfa crop. It appears, then, that when the object of grain farming is primarily for the purpose of rotating an alfalfa field double cropping may be profitably practiced.

Of 627 farms studied, there were 42 upon which the greater portion of the receipts was obtained from grain and 22 upon which grain farming was combined with some other enterprise. The results obtained are shown in Table XVI.

TABLE XVI.—*Results obtained with grain farming in the irrigated valleys of southern Arizona, 1913–1915.*

Type of farming and percentage of receipts from principal enterprises.	Number of farms.	Average area.	Number failing to make 8 per cent.	Average receipts.	Average farm income.	Average labor income.
		Acres.				
Grain, 62.8	42	203	14	$5,187	$2,807	$541
Grain, 36.4 Hay, 43.7	19	97	8	3,212	1,803	143
Grain, 44.8 Poultry, 23.4	2	30	1	1,170	835	249

COTTON FARMING.

Cotton farming is a new enterprise in Arizona, making its first appearance [1] in Salt River Valley in 1912, when several hundred acres were grown. In 1913 the enterprise expanded to over 4,000 acres, and in 1914 it had expanded to 11,501 acres in Salt River Valley and 2,260 acres in Yuma Valley, according to the crop report of the United States Reclamation Service for that year. The low price obtained for the crop of 1914 set the acreage in Salt River Valley back to less than 2,000 in 1915 and almost eliminated the crop from Yuma Valley. The price paid for Egyptian cotton lint averaged about 15 cents a pound in 1914, while in previous years

[1] About 100 acres of cotton were grown at Arlington in 1908 and a gin was built to take care of the crop, but the venture was not a commercial success at this time and so the real beginning of the enterprise was in 1912, since which date more or less cotton has been grown every season.

the price had averaged about 20 cents. In 1915 the price again went back to about 20 cents and in 1916 Egyptian cotton lint sold as high as 70 cents a pound f. o. b. at Phoenix, the most of the crop selling as high as 40 to 45 cents. It is reported that owners of gins offered to contract for the 1917 crop in advance at 27 cents. The area planted to Egyptian cotton in 1917 was over 45,000 acres.

With such variable prices records of the farm business are of little value in establishing the place of Egyptian cotton in any system of organization that might be proposed for the farms in the irrigated valleys of southern Arizona. It may be stated, however, that 28 farms obtaining over 40 per cent of their receipts from Egyptian cotton, the average percentage being 66.9 per cent, produced average yields of 423 pounds of lint per acre, which was sold at an average price of 15.9 cents per pound. The seed brought an average of $14.20 per ton. The farms averaged 88 acres in size and the general results were as follows: Receipts, $4,176; farm income, $1,810; labor income, $541. These results compare favorably with hay farming, but are far below those obtained in dairy farming during the same period of study. When the cotton is valued at 20 cents a pound, however, the results become: Receipts, $4,670; farm income, $2,370; labor income, $1,117. These results compare favorably with those obtained in dairying, while with the price of cotton as high as it was in 1916, even though labor advanced at least 50 per cent, the enterprise was more profitable than dairying, although there was also a considerable increase in the price paid for dairy products. There were 76 records of farms upon which cotton was grown to a greater or less extent, the most of these being taken in 1914 and none after that year, and these were arranged in four groups based upon increasing percentage of receipts from cotton. Both farm income and labor income decreased steadily as the percentage of receipts from cotton increased with the average price of cotton between 15 and 16 cents a pound.

It may be safely stated, therefore, that with yields as high as 400 pounds of lint, and with a price as low as 15 cents a pound, cotton farming is not so profitable as other well-established enterprises, but since the price has been below 20 cents but one year out of the six in which it has been grown in Arizona, the enterprise may be strongly recommended to supplement the live stock interests now so firmly established in these districts, the crop proving admirably adapted for rotation with alfalfa. Picking charges during the period covered by these studies were uniformly 2 cents a pound for seed cotton and ginning charges were $10 a bale. The picking was done almost entirely by Indian labor.[1]

[1] See Farmers' Bulletin 577, "Growing Egyptian Cotton in the Salt River Valley," and Bureau of Plant Industry Bulletin 128, "Egyptian Cotton in Southwestern United States."

FRUIT.

Out of the 627 farms studied 19 were devoted chiefly to fruit raising, obtaining an average of 74.2 per cent of their total receipts from fruit, and the enterprise was prominent on about a dozen diversified farms. The fruit farms are nearly all small, the average size of the 19 studied being 25 acres. The varieties of fruit grown were chiefly peaches, apricots, grapes, and citrus fruits. (See fig. 12.)

Fruit farming pays a relatively high farm income, considering the size of the farms, but the labor income is less satisfactory because of the large interest charge due to the high value placed on developed

FIG. 12.—An orange grove in Salt River Valley.

orchards. The enterprise is somewhat more speculative than such enterprises as dairying or hay farming, and there are a proportionately larger number of fruit growers who fail to make current interest rates on their investment.

A thorough study of the cost of developing orchards and of market facilities will be necessary before any safe predictions can be made regarding the possibilities of expanding this enterprise. Results obtained on the farms studied are as follows: Average receipts, $2,288; farm income, $1,498; labor income, $205. Eight out of the 19 farms failed to pay current interest rates on the investment.

TRUCK FARMING, HOME GARDENING, AND CANTALOUPES.

Truck farming is carried on largely by Chinese and Japanese gardeners, who also import large quantities of vegetables from California and peddle them from house to house both in the towns and in the country. The farms are all small and their number is

not large. Only a few records on such farms were taken. The results obtained on six truck farms averaging 14.5 acres and upon which truck contributed 84.3 per cent of the total receipts were: Average total receipts, $824; farm income, $478; labor income, $110.

Even home gardening is unpopular, gardens being found upon but 22.7 per cent of the farms studied. It is claimed by those who do not have gardens and by many who do that gardening does not pay. Gardens must be irrigated oftener than once per week and after every irrigation they must be cultivated. It is not always convenient to receive the water upon a farm at the time when the garden needs watering, and garden irrigation is therefore neglected. During the summer season the intense heat makes it difficult or impossible for women and children to work in the garden, while larger and more profitable farm enterprises require all the time of man labor. Weeds grow rapidly and all soils but the more sandy ones harden quickly after irrigation, even when cultivated, making an uncongenial home for garden plants. Gardening may be carried on during the winter months, but the number of plants growing during this season is limited, their growth is slow, and they are often injured by frosts. Plant lice multiply rapidly at all seasons of the year and are a constant menace to garden plants. Chinese peddlers import vegetables from California and visit the farmers two or three times a week, extending their routes out as far as 14 miles from the city, and sell vegetables at prices stated by the farmers to be lower than it would cost them to produce them on their farms. Many farmers had kept books on their gardening operations, and these were very positive in their statements that the enterprise does not pay. In the Gila Valley, where the climate is somewhat cooler, gardening could be more successfuly carried on in spring and summer than in either Salt River Valley or Yuma Valley; but here the water runs are more irregular and less certain and therefore gardening is but little more popular than in the other two valleys.

Approximately 2,000 acres of cantaloupes are planted every year in Salt River Valley, but the enterprise is not found to any extent in either of the two other valleys. They are grown almost exclusively on contracts with eastern commission firms, who furnish the seed and send inspectors to the field to superintend cultivation, picking, and packing. The firms contract to advance a stated amount per crate when the cantaloupes are received for shipment, the amount rarely exceeding the cost of production and more frequently not equaling it. The cantaloupes are then shipped and sold on commission, the charge by the firm usually being 15 per cent, the farmer paying all expenses, including freight, icing, cartage, and cost of crates. The returns received by the farmers fluctuate violently, being sometimes high enough to make the enterprise extremely profitable and

at other times so low that the farmers must draw upon the income from other enterprises to pay the freight bills. The enterprise is thus highly speculative, and, unless conditions should change radically, can never become of great importance in southern Arizona.

The relative importance on the farms studied of the enterprises that have been described is shown further in Table XVII, which presents the total receipts on 725 farms arising from each of the various enterprises.

TABLE XVII.—*Distribution of receipts among the various enterprises on 725 irrigated farms in southern Arizona.*

Enterprise.	Value of total receipts.	Enterprise.	Value of total receipts.
Dairying:		Cotton and cotton seed	$146,889
Net sales of dairy cattle over purchases	$76,339	Alfalfa pasture	130,324
Increase in dairy cattle	[a] 273,556	Barley	119,440
Sales of butter and retail milk	76,987	Horses	89,628
Sales of cream	297,858	Grain sorghums	81,081
Total, dairying	724,740	Miscellaneous sources	64,229
Alfalfa hay	458,899	Fruit	60,726
Beef cattle	418,751	Alfalfa seed	53,335
Hogs	180,347	Sheep, goats, wool, and mohair	22,805
Poultry and poultry products	156,951	Cantaloupes	18,279
Wheat	162,446	Truck and watermelons	13,651
		Oats	11,106
		Corn	8,171
		Irish potatoes and beans	3,015

[a] This increase in value of dairy live stock is due to increase in numbers rather than to increase in value of individual animals.

THE ADAPTATION OF THE FARM ENTERPRISES TO THE SIZE OF THE FARM.[1]

In the group of 54 farms of 19 acres or under were 12 dairy farms, 10 poultry farms, 9 fruit farms, and 5 diversified farms. There were 6 farms on which dairying was combined with some other enterprise and 4 upon which poultry was combined with some other enterprise. The remaining 8 farms in the group were devoted to various crop enterprises. Dairy, poultry, and fruit, and their various combinations, give much better results on these farms than other enterprises including diversified farming. The average receipts, farm income, and labor income of the 41 farms devoted to these three enterprises were $1,185, $760, and $313, respectively, while the corresponding figures for the 13 other farms were: Receipts, $700; farm income, $516; labor income, $120.

Among the 45 farms of 20 acres there were 15 dairy farms, 4 poultry farms, 4 farms that combined poultry with dairying, 2 fruit farms, 3 truck farms, 5 hay farms, 2 farms upon which hay and grain were combined, 7 diversified farms, and 3 beginners with enterprises not thoroughly established. The dairy and poultry organization produced average results on the 23 farms as follows: Receipts,

[1] See Table XXI for classification of farms according to size.

$1,702; farm income, $1,161; labor income, $535. The 12 farms devoted chiefly to raising crops, including the fruit and truck farms, produced average results as follows: Receipts, $1,163; farm income, $698; labor income, $195. The corresponding figures for the 7 diversified farms were: Receipts, $1,250, farm income, $698; labor income, $332.

In the group of 54 farms, ranging in size from 21 to 39 acres, 17 farms were devoted chiefly to dairying, 3 to poultry, 2 to grain, 4 to fruit, 8 to hay, 3 to cotton, and 17 to diversified enterprises. Hay farming pays proportionately better in this group of farms than in other groups because of more intensive methods in cultivation, curing, and marketing. The 8 hay farms averaged as follows: Receipts, $1,848; farm income, $1,256; labor income, $469. The 4 fruit farms produced by far the largest returns of any types found in the group, as measured in net farm income, but because of the high valuation placed on the land they failed to pay 8 per cent interest on the investment and therefore produced minus labor incomes. The returns from these farms were as follows: Receipts, $3,191; farm income, $2,447; labor income, $−37. The returns from the 17 dairy farms were: Receipts, $1,795; farm income, $1,327; labor income, $526. Dairying, therefore, is one of the most profitable enterprises found on these farms. Diversified farming in which dairying was the leading enterprise also paid well, the average returns from the 17 diversified farms being: Receipts, $1,691; farm income, $1,249; labor income, $572. The average returns for the 54 farms in the group were: Receipts, $1,874; farm income, $1,317; labor income, $450. A considerable number of the dairy farmers in this group as well as in the two groups of smaller farms retail their milk, but the majority of them patronize the creameries.

On the farms of 40 acres, dairying is the most prominent as well as the most profitable enterprise found. Of 84 farms studied, 34 were devoted almost entirely to dairying, and 9 others were devoted to a combination of dairying with some other enterprise, the two enterprises occupying about equal positions in the farm organization. There were 13 hay farms and 16 diversified farms. Among the remaining 12 farms, 1 was a hay and grain farm, 1 a fruit farm, 2 were grain farms, 3 were cotton farms, 1 produced cantaloupes, 3 produced alfalfa seed, and 1 was pasture. The average returns from the 43 dairy farms were: Receipts, $2,186; farm income, $1,557; labor income, $653. Nearly all the dairy farmers in this group patronized the creameries. The returns from the 25 farms obtaining 82.2 per cent of their receipts from the sale of crops were: Receipts, $1,852; farm income, $1,093; labor income, $181. Thus it is seen that a dairy organization on these farms pays an average of $464 more per year than an organization based upon the sale of crops. The average

returns from the 16 diversified farms upon which live stock contributed 58.6 per cent of the total receipts and crops 39.5 per cent were: Receipts, $1,971; farm income, $1,389; labor income, $489.

Of 103 farms ranging in size from 41 to 79 acres there were 33 dairy farms, 27 of which were devoted almost entirely to dairying and 6 to dairying and 1 other enterprise. In addition to these there were 23 diversified farms upon which dairying was the leading enterprise. There were 21 hay farms and 5 hay and grain farms. The remainder of the farms in the group were devoted to various enterprises as follows: Beef cattle, 3; poultry, 2; alfalfa seed, 4; fruit, 3; cotton, 7; bees, 2.

The 4 alfalfa-seed farms gave remarkably high returns, as follows: Receipts, $4,646; farm income, $2,961; labor income, $1,855. The 2 bee farms likewise gave high returns, but bee farming is a specialized enterprise for which the demand is limited.

Thirty-eight farms with a live stock organization based upon dairying, and upon which live stock contributed 84.2 per cent of the total receipts, gave returns as follows: Receipts, $2,775; farm income, $1,931; labor income, $721. Forty farms with an organization based upon the sale of crops, and upon which crops contributed 81 per cent of the total receipts, gave returns as follows: Receipts, $3,174; farm income, $1,834; labor income, $574. Twenty-three diversified farms, upon which live stock contributed 53.7 per cent of the total receipts and crops 46.3 per cent, produced the following average returns: Receipts, $2,651; farm income, $1,736; labor income, $490.

Also on farms of 80 acres, dairying occupies a prominent place, there being 24 farms out of 75 devoted chiefly to dairying and 4 to dairying and 1 other enterprise. There were 10 hay farms, 8 grain farms, and 15 diversified farms, dairying being the leading enterprise on the diversified farms. The remainder of the farms in the group were devoted to enterprises as follows: Poultry, 2; beef cattle, 1; alfalfa seed, 2; hogs, 1; cotton, 4; pasture, 3; potatoes and grain, 1.

Thirty-two farms with a live-stock organization in which live stock furnished 83.3 per cent of the total receipts produced average returns as follows: Receipts, $3,842; farm income, $2,671; labor income, $1,264. The corresponding figures for 28 farms with an organization based upon the sale of crops and upon which crops furnished 82.8 per cent of the total receipts were: Receipts, $3,155; farm income, $1,820; labor income, $548. The average results obtained on the 15 diversified farms were: Receipts, $2,688; farm income, $1,683; labor income, $427. The live stock organization gave returns averaging $851 better than the crop organization and $988 better than an organization based upon diversified enterprises.

In the group of 47 farms ranging from 81 to 119 acres, dairying was not as prominent as in preceding groups, and about half of the men

engaged in dairying were beginners in the enterprise and had not yet brought it to its highest degree of success. Ten farmers who depended chiefly upon dairying for their receipts were very successful, obtaining returns comparing favorably with returns from this enterprise on the farms of the 80 acres, but five other farmers who attempted to combine dairying with hay, hogs, or grain, were very unsuccessful. One sheep farmer was also very unsuccessful, and two beef cattle farmers were only moderately successful. The live stock organizations upon these farms, therefore, produce average returns relatively much lower than returns from organizations of this kind on the farms of 80 acres. This difference is due to imperfection in the live stock organization itself. The five diversified farms in the group are nearly as successful as the 10 dairy farms, but they obtain an average of 29.4 per cent of their receipts from dairying, this enterprise being in every case much the strongest of the three or more enterprises found on these farms. Results obtained with some of the more successful enterprises were as follows: Ten dairy farms, receipts, $4,124; farm income, $2,855; labor income, $1,089. Five diversified farms, receipts, $4,056; farm income, $2,479; labor income, $931. Two alfalfa seed farms, receipts, $4,412; farm income, $3,024; labor income, $1,297. Two cotton farms, receipts, $5,784; farm income, $2,536; labor income, $927. Twenty farms devoted chiefly to hay, grain, or pasture were comparatively unprofitable, their average returns being: Receipts, $3,015; farm income, $1,713; labor income, $130.

On 39 farms ranging in size from 120 to 159 acres, enterprises were found distributed as follows: Dairying, 11 farms; beef cattle and dairy, 2; alfalfa seed, 1; hay, 6; hay and grain, 1; pasture, 3; cotton, 3; cotton and hogs, 1; grain, 5; diversified, 6. Some of the more satisfactory results obtained were as follows: Eleven dairy farms produced averages of, receipts, $6,275; farm income, $3,821; labor income, $1,602. Six diversified farms, receipts, $6,024; farm income, $4,224; labor income, $1,722. One alfalfa seed farm, receipts, $4,303; farm income, $2,825; labor income, $1,406. One combination hogs and cotton farm,[1] receipts, $11,290; farm income, $6,443; labor income, $4,235.

Thirteen farms with a live stock organization, live stock contributing 83.4 per cent of the total receipts, produced average returns as follows: Receipts, $6,034; farm income, $3,699; labor income, $1,410. The corresponding results obtained on 20 farms organized on the basis of sales of crops, upon which crops contributed 80 per cent of the total receipts, were, receipts, $4,747; farm income, $2,473; labor income, $473.

[1] The farmer in this case was engaged largely in the business of buying hogs, keeping them a short time on his farm, and then selling them, rather than raising the hogs on his own farm.

In the group of 44 farms of exactly 160 acres each, were 17 strictly dairy farms and 3 upon which dairying was combined with hay or grain. The strictly dairy farms were highly successful, producing returns as follows: Receipts, $7,312; farm income, $4,976; labor income, $1,958. The combinations of dairying with hay or grain were comparatively unsuccessful, the three farms producing average returns as follows: Receipts, $5,618; farm income, $2,353; labor income, $343. There were 5 hay farms, 7 grain farms, and 2 farms upon which hay and grain farming were combined. The average results obtained on these 14 farms were: Receipts, $4,748; farm income, $2,426; labor income, $416.

The remaining 10 of the 44 farms in this group were devoted to enterprises as follows: Three hog farms, 2 beef cattle farms, 2 pasture farms, and 3 diversified farms. The 2 beef cattle farms produced results somewhat lower than those obtained on the dairy farms, and the 2 pasture farms produced results somewhat below the average for the whole group. The diversified farms and hog farms were comparatively unsuccessful.

The average results obtained on 25 farms having a live stock organization in which live stock contributed 75.7 per cent of the total receipts were: Receipts, $6,784; farm income, $4,346; labor income, $1,491. The corresponding results on 16 farms with an organization based on the sale of crops, with crops contributing 81.6 per cent of the total receipts, were: Receipts, $4,698; farm income, $2,534; labor income, $486. The live-stock organization shows an average return of $1,812 more per farm than the organization based upon the sale of crops.

On the 50 farms ranging in size from 161 acres to 320 acres dairying is not quite as prominent as on the farms below this size, beef cattle coming into more prominence and largely taking the place of dairying in the live-stock organization. Dairying is not entirely displaced by beef-cattle farming, however, and there are still many successful dairy farms among the larger farms. The enterprises found on these 50 farms were distributed as follows: Dairying, 9 farms; beef cattle, 11; beef cattle and hay or grain, 2; hogs and pasture, 2; sheep and diversified animals, 2; hay, 6; grain, 6; pasture and alfalfa seed, 3, and diversified, 9.

The dairy farms gave the highest returns, the average for the nine farms being: Receipts, $11,102; farm income, $6,606; labor income, $2,567. The six hay farms were unusually successful for this type of farming, the average returns being: Receipts, $9,556; farm income, $5,593; labor income, $1,644.

The farms devoted chiefly to beef cattle were more successful than the average for the group, but did not produce as high returns as the dairy farms. The two farms that tried combining beef cattle with

group of largest farms, and in these two groups the rate would be very close to that paid by the farms of 40 acres. Farms ranging in size from 40 to 160 acres pay the highest rate of interest.

TABLE XXVI.—*Relation of size of farm to rate of interest earned on capital invested.*

Size group.	Area.	Average total investment.	Farm income plus farm contribution to family living.	Operator's valuation of his labor and managerial ability.	Amount earned on investment.	Rate earned on investment.
Acres.	*Acres.*					*Per cent.*
0 to 19	11	$5,417	$956	$528	$428	7.90
20	20	7,205	1,220	515	705	9.79
21 to 39	30	10,845	1,660	597	1,063	9.80
40	40	11,119	1,688	554	1,134	10.20
41 to 79	62	15,401	2,215	672	1,643	10.02
80	80	16,584	2,461	659	1,802	10.87
81 to 119	101	20,929	2,508	672	1,836	8.77
120 to 159	137	27,050	3,484	771	2,713	10.03
160	160	32,158	3,938	844	3,094	9.62
161 to 320	244	46,963	5,310	1,000	4,310	9.18
Over 320	530	89,470	9,286	1,159	8,127	9.08

There is a definite relation between size of farm and the magnitude of the receipts, expenses, percentage of receipts paid out in expenses, and the percentage of expenses paid for labor. These relations are shown in Table XXVII.

TABLE XXVII.—*Relation of size of farm to receipts, expenses, percentage of receipts paid out in expenses, and per cent of expenses paid for hired labor on irrigated farms in southern Arizona.*

Average area.	Number of farms.	Receipts.	Expenses.	Per cent of receipts paid out in expenses.	Per cent of expenses paid for hired labor.
Acres.					
11	54	$1,080	$382	35.4	24.1
20	45	1,416	481	34.0	28.7
30	54	1,874	557	29.7	27.3
40	84	2,045	658	32.2	29.6
62	103	2,907	1,045	35.9	44.5
80	75	3,357	1,201	35.5	40.5
101	47	3,612	1,457	40.2	44.8
137	39	5,526	2,385	43.1	50.8
160	44	5,951	2,361	39.7	51.0
244	50	8,465	3,546	41.9	51.2
530	32	16,354	7,420	43.7	49.0

There is a common belief in Arizona that the expenses in running a small farm are much less than those incurred in operating a large farm. While this is true abolsutely, it is not in general true relatively. Table XXX shows that the percentage of receipts paid out in expenses does not vary greatly in any of the size groups, and that this percentage is as large on farms smaller than 20 acres as it is on farms of 80 acres. On farms larger than 80 acres the percentage rises slightly, but the rise is not great enough to verify the common opinion. The percentage of expenses paid out for labor is progressively larger on

the larger farms, but the advantage the smaller farms have in labor expense is nearly overcome by proportionately greater expenses for taxes, feed, and water.

The distribution of expense on farms of different size is shown in Table XXVIII.

TABLE XXVIII.—*Distribution of expenses on farms of different sizes in the irrigated valleys of southern Arizona.*

Average size.	Hired labor.	Family labor.	Thrashing and baling.	Repairs on machinery.	Feed purchased.	Taxes.	Water.	Miscellaneous.	Total.
Acres.									
11	$92	$20	$10	6	$140	$38	$18	$58	$382
20	138	21	16	8	116	61	33	88	481
30	152	39	59	9	74	91	47	86	557
40	194	70	77	16	72	95	58	76	658
62	465	115	105	16	63	129	85	67	1,045
80	486	81	123	16	100	148	112	135	1,201
101	652	161	177	21	63	194	126	63	1,457
137	1,212	140	191	40	140	243	190	229	2,385
160	1,203	211	209	44	106	281	210	97	2,361
244	1,814	177	241	63	266	382	295	308	3,546
530	3,636	118	597	148	288	842	668	1,123	7,420

While it has been shown that the smaller farms do not furnish as large a farm income as the larger farms, and do not pay as high wages to the operators, it is yet possible to make incomes of considerable size even on the small farms. This is shown in Table XXIX, which presents the maximum and minimum farm incomes made in each size group, and the percentage of farms in each group making a farm income of $1,500 or more.

TABLE XXIX.—*Maximum and minimum farm incomes made in the different size groups, and the percentage of farms in each group furnishing an income of $1,500 or more.*

Size-group, acres.	Number of farms.	Average area.	Maximum farm income.	Minimum farm income.	Percentage of farms in group furnishing incomes of $1,500 or more.
		Acres.			
0 to 19	54	11	$2,621	$151	5.6
20	45	20	3,359	97	15.6
21 to 39	54	30	3,876	69	29.6
40	84	40	4,711	25	27.4
41 to 79	103	62	5,492	347	62.1
80	75	80	5,323	88	74.7
81 to 119	47	101	4,692	723	80.9
120 to 159	39	137	7,707	834	92.3
160	44	160	9,062	860	90.9
161 to 320	50	244	14,266	385	98.0
Over 320	32	530	24,215	3,386	100.0

Since in all tables hitherto presented the results have been average results of all farms of a class, and therefore have been proportionately influenced by the poorer farms as well as the better ones, and since in all communities there are always a few farmers who fail, no matter what the circumstances may be, it will perhaps add to the

completeness of the data herein presented to make two groups of farms, one consisting of all those farmers who made over 8 per cent interest on their investment, and the other consisting of all farmers failing to make 8 per cent on investment, and present comparative data in the two groups. Such data are presented in Table XXX. In this table the contribution of the farm to the family living was omitted, and the value of the farmer's labor was not deducted in calculating rate of interest.

The table shows that there are 161 farmers out of 627 who with an average of 98 acres each can make only 5.9 per cent on their investment by devoting their whole time to the work, while there are 466 farmers with only 8 acres more land that can make 13 per cent on their investment in the same manner. The average investment in the two groups of farms is almost the same, though the price of the land in the group making the lower profit is $30 per acre greater than in the other group. The more successful farmers make an average of $1,705 more per year than those who are less successful. The average expenses are almost the same, so the difference in farm income in the two groups is due almost entirely to differences in total receipts. The factors affecting total receipts have been discussed quite fully under the various farm enterprises, and need no further discussion here.

TABLE XXX.—*Comparison of farms making a relatively high interest rate on investment with farms making a relatively low interest rate.*

Size group.	Average area.	Number of farms.	Average receipts.	Average farm income.	Average labor income.	Average expense.	Value of land per acre.	Investment per acre.	Working capital per acre.	Investment per farm.	Interest rate.
FARMS PAYING MORE THAN 8 PER CENT ON INVESTMENT.											
Acres.	*Acres.*										*Per ct.*
0 to 19	11	42	$1,152	$794	$376	$358	$376	$475	$99	$5,225	15.2
20	20	26	1,821	1,341	436	480	267	361	94	7,232	18.5
21 to 39	30	40	1,968	1,415	705	553	228	296	67	8,871	15.9
40	40	62	2,324	1,677	828	647	199	265	66	10,587	15.8
41 to 79	61	76	3,127	2,132	973	995	190	237	47	14,487	14.7
80	80	62	3,658	2,393	1,050	1,265	160	210	50	16,796	14.3
81 to 119	117	32	4,066	2,512	897	1,554	152	188	36	20,181	12.4
120 to 159	138	32	5,838	3,487	1,375	2,351	145	192	47	26,398	13.3
160	160	32	6,656	4,294	1,662	2,362	155	206	51	32,902	13.1
161 to 320	249	37	9,365	5,624	1,919	3,741	141	186	45	46,314	12.1
Above 320	525	25	17,131	10,359	3,069	6,772	135	173	38	91,160	11.4
All farms	106	466	4,480	2,995	1,132	1,485	157	204	47	21,668	13.0
FARMS FAILING TO PAY 8 PER CENT ON INVESTMENT.											
0 to 19	11	12	$823	$361	— $126	$462	$427	$526	$99	$6,090	5.9
20	20	19	862	379	— 195	483	307	358	51	7,168	5.3
21 to 39	30	14	1,608	1,037	— 282	571	480	543	63	16,484	6.3
40	40	22	1,256	571	— 445	685	264	315	51	12,618	4.5
41 to 79	63	27	2,287	1,102	— 336	1,185	236	287	49	17,977	6.1
80	80	13	1,924	1,022	— 224	902	167	195	28	15,577	6.6
81 to 119	100	15	2,641	1,393	— 409	1,248	194	225	28	22,523	6.2
120 to 159	135	7	4,100	1,562	— 840	2,538	180	222	42	30,025	5.2
160	160	12	4,072	1,712	— 677	2,360	156	189	33	30,172	5.7
161 to 320	232	13	5,904	2,912	—1,000	2,992	175	211	36	48,808	6.0
Over 320	547	7	13,581	5,121	—1,539	8,460	124	153	29	83,436	6.1
All farms	98	161	2,796	1,290	— 466	1,506	187	224	37	21,951	5.9

The labor income is affected both by the total receipts and the price of the land, higher priced land calling for a higher interest charge against the farm income, and lessening the labor income to that extent unless the higher priced land produces correspondingly higher receipts. Where the element of speculation is not present the price of land is usually a good measure of its agricultural value, but where speculative values are attached to the land the returns obtained by farming may not be in any way commensurable with the price.

In both groups of farms the average farm income rises with the size of the farm, but in the group failing to make 8 per cent the minus labor income becomes greater as the size of farm advances, since on a losing rate of interest the greater the capital invested the greater will be the loss.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 655

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

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INFLUENCE ON LINSEED OIL OF THE GEOGRAPHICAL SOURCE AND VARIETY OF FLAX.[1]

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Office of Drug-Plant and Poisonous-Plant Investigations.

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INTRODUCTION.

The cultivation of flax for the production of flaxseed and for linseed oil is at present receiving the most careful attention of agriculturists as well as manufacturers. The interest in this important problem is twofold. The matter resolves itself into a problem of rehabilitation of the crop on the one hand, due to a diminishing acreage and yield of seed, while on the other hand interest is stimulated by the constantly increasing demand for the manufactured products with the growing scarcity of the linseed oil used in their manufacture. Practically the whole output of linseed oil is consumed in the manufacture of paints and varnishes and other allied materials where protective coatings are desired.

In view of these conditions, it is important that attention be directed at the present time to the improvement of the crop and the oil. The desired results can best be accomplished by a combined agronomic and chemical investigation of the subject. The investigation should embody a study of the culture of the plant for the production of seed, supplemented by a thorough study of the oil from the standpoint of yield and quality.

[1] The work discussed in this paper was carried out in cooperation with the Office of Cereal Investigations of the Bureau of Plant Industry. The writer wishes to express his thanks to Mr. C. H. Clark, assistant agronomist, in charge of flax investigations in that office, who supplied the samples, and to Mr. J. D. McIntyre, of the Office of Drug-Plant and Poisonous-Plant Investigations, who rendered assistance in the extraction of the oils.

The growth of the plant, as well as the yield and quality of the oil, will be influenced to a certain degree by geographical location with the varying conditions of soil and climate. Therefore the cultivation of the plant in various geographical locations followed by analysis of the oil, both as regards yield and quality, serves as an excellent combination for comparison with respect to the effect of plant selection and geographical source upon the oil. A study of this problem was accordingly undertaken along the lines mentioned.

During two successive seasons selected varieties of flax were grown in widely separated localities having different soil and climatic conditions. The oil was extracted from the seeds of different varieties thus obtained and the various oils compared each year in order to ascertain any existing differences in composition in the different varieties when grown in one or several localities. The varieties upon which these studies were made represented two or more distinct types of flax. The quality of these oils from the standpoint of their usefulness as paint and varnish oils was studied and this information made available for use in the selection of varieties combining yield and quality of oil in any one or all localities.

VARIETIES OF FLAX.

Four varieties of flax were chosen and used as a basis for the investigation. These were selected by the Office of Cereal Investigations as representing two distinct types of seed flax. Reference will be made to the varieties as C. I. (Cereal Investigations) numbers.

The four varieties grown and tested for oil content and composition are as follows: C. I. No. 3, Damont (North Dakota 1215); C. I. No. 12, Primost (Minnesota No. 25); C. I. No. 13 (North Dakota Resistant No. 114); C. I. No. 19 (Russian). C. I. Nos. 3 and 19 represent typical seed-flax varieties, while C. I. Nos. 12 and 13 are earlier maturing and resistant varieties yielding less under semiarid conditions.

These varieties were grown during the seasons of 1914 and 1915 at stations located as follows: Moccasin, Mont.; Dickinson and Mandan, N. Dak.; Newell and Highmore, S. Dak.; Archer, Wyo., and Burns, Oreg. These stations are located in more or less widely separated flax-growing localities where the conditions of soil and climate are likewise different.

The conditions at the various stations with respect to altitude, soil, precipitation, and evaporation are shown in Table I.

Considerable variation in latitude and longitude exists between the several stations. The variation in longitude is 19° 40′ and in latitude 5° 18′. The northernmost stations are Moccasin, Mont., and Dickinson, N. Dak.; the southernmost is Archer, Wyo. Highmore, S. Dak., is located farthest east, while Burns, Oreg., is the most westerly station.

TABLE I.—*Location, soil, and climatic conditions of the seven stations where flax experiments were made during the seasons of 1914 and 1915.*

[Data from the records of the Biophysical Laboratory of the Bureau of Plant Industry.]

Station.	Latitude N.	Longitude W.	Altitude in feet.	Soil.	Year.	Precipitation for 5 months, April to August.	Evaporation for 5 months, April to August.
	° ′	° ′				*Inches.*	*Inches.*
Moccasin, Mont.	47 00	109 45	4,300	Dark clay loam; gravel subsoil.	1914	10.03	27.173
					1915	11.98	25.059
Dickinson, N. Dak.	47 00	103 00	2,453	Sandy to heavy clay loam	1914	18.84	26.975
					1915	14.77	21.06
Mandan, N. Dak.	47 00	101 00	1,750	Sandy loam	1914	19.04	28.894
					1915	19.52	24.969
Newell, S. Dak.	44 35	103 26	2,950	Pierre clay gumbo	1914	7.86	30.917
					1915	15.82	22.501
Highmore, S. Dak.	44 30	99 20	1,890	do	1914	13.06	.....
					1915	17.18	.....
Archer, Wyo.	41 42	104 15	6,027	Sandy loam; some gravel	1914	8.56	.....
					1915	12.69	25.356
Burns, Oreg.	43 00	119 00	4,100	Variable silt loam	1914	4.27	35.456
					1915	2.90	34.893

The soil at the different stations varies from a silt loam at Burns, to a clay gumbo at Highmore and Newell. The remaining stations possess sandy or clay-loam soils. The total precipitation during the growing months at the different stations varied considerably during the two seasons. The evaporation shows wide differences also.

The variation in location, soil, and climate doubtless affected the growth and development of the flax plants and therefore also affected the formation and development of the fatty oil in the seeds.

FACTORS WHICH INFLUENCE THE COMPOSITION OF THE OIL.

Conditions of soil and climate are important factors influencing the growth of a plant, and they act jointly in affecting the content and composition of the fatty oil in the plant. The availability of the fertilizer ingredients of soils is due to a large extent to the amount of moisture present, which in turn is dependent upon certain other conditions, such as heat, light, humidity, and altitude. Whether the soil is light or heavy in texture is important in making its constituents available to the plant. Likewise, the retention of moisture by some soils and the lack of retention by others naturally affect the growth and development of the plant and the formation of oil in the plant. Any cause which tends to modify the growth or nutrition of a plant will have a material effect upon the formation of the fat in the seed of the plant. Woods [1] states that the texture and structure of the soil affects decidedly the availability to the

[1] Woods, A. F. The relation of nutrition to the health of plants. *In* Yearbook, U. S. Dept. of Agr., for 1901, p. 157.

plant of the soil foods with air and water. Garner, Allard, and Foubert [1] have shown that climatic conditions exert a marked influence upon the oil content of certain seeds. Provided the content of oil is affected by environmental conditions it is very probable that the composition or the proportion of the component parts of the oils is likewise modified and altered.

Pigulevskii [2] has found from an examination of numerous plants in respect to oil content and composition that the nature of the oil in a plant is influenced by climatic conditions and possibly also by conditions of nutrition. A large number of plants of the same family grown in different parts of Russia yielded oils the nature of which varied with climatic conditions.

The effect of such climatic conditions as latitude, temperature, sunshine, and rainfall have been studied by Wiley [3] and found to influence the sugar content of sugar beets strongly. Likewise, the starch and protein content of the wheat grain have been found to be influenced by season and climate.

Various localities will be found to have varying conditions of climate and soil, the extremes and means of which act in either facilitating or retarding the growth of the plants and therefore affect favorably or unfavorably the formation of oil in the seeds.

PLAN OF COMPARISON OF THE OILS.

The present investigation was undertaken in order to compare the oils from the various flax samples grown at the several stations during the two successive seasons. The comparison in question should determine tentatively those varieties producing seeds with the highest yield of oil as well as oil of the best quality. Information of such character is of the utmost importance in connection with the production and improvement of this staple crop. However, it is not only important to ascertain the high oil-yielding varieties of seeds, but the properties and general behavior of the oils are of equal importance. The physical and chemical properties of the oils determine their value to a large extent. In order to facilitate the best comparison, only those properties which admit of accurate measurement and which have a direct bearing upon the quality of the oils were considered.

Color, specific gravity, and index of refraction are important physical properties in which variations can easily be detected. Since the color of most drying oils is an important consideration, but does not admit of measurement, it was necessary to describe

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[1] Garner, W. W., Allard, H. A., and Foubert, C. L. Oil content of seeds as affected by the nutrition of the plant. *In* Journ. of Agr. Res., U. S. Dept. Agr., v. 3, p. 248. 1914.

[2] Pigulevskii, C. V. *In* Zhurn. Russk. Fiz.-Khim. Obshch., v. 47, p. 393–405, 1915; v. 48, p. 324–341, 1916.

[3] Wiley, H. W. Influence of environment on composition of plants. In Yearbook, Dept. of Agr., for 1901, p. 307, 310.

this property as carefully as possible. The specific gravity and the refractive index, which have much significance as regards the general composition of the oils, were readily determined.

The chemical properties are perhaps most important from the standpoint of the composition of the oils. The acid, saponification, and iodin values are the most important chemical constants. The acid value of the linseed oils is affected by a number of conditions. Factors such as rain or moisture during harvest and the storing of the moist flax after harvest, which would tend to produce molding of the seed, will modify considerably the acid value of the oil. The saponification value representing the sum of the acid and ester values is a combined measure of the free acids and glyceryl esters contained in the oil.

Linseed oil consists for the most part of glyceryl esters of linoleic and linolic acids. These unsaturated fatty acids possess the property of absorbing iodin. This property is known as the iodin value and is perhaps the most important of the chemical constants. The iodin value is a direct criterion of the proportion of these fatty acids present in the oil, and since these acids determine the drying property of linseed oil the iodin value becomes an index of this property.

The usefulness of linseed oil in the industries is based upon the property of the oil to dry to a tough elastic film when exposed in thin layers to the air. This oil is a typical example of a class of fatty oils known as drying oils. Oils of this character are composed largely of glycerids of unsaturated fatty acids which possess the property of absorbing oxygen when exposed to the air. The absorption of oxygen by linseed oil alters its composition and is accompanied by the formation of a compound known as linoxyn, which constitutes the tough elastic skin so familiar when the oil is allowed to dry. The usefulness of linseed oil as a protective coating is due entirely to the formation of the compound linoxyn, which is resistant to the effects of heat and moisture of the outside elements to a remarkable degree.

Coincident with the absorption of oxygen there occurs an increase in the weight of the oil, and the more rapid the increase in weight the greater is the rapidity of drying, and vice versa. Advantage was taken of this property in order to determine the relative drying value of the various oils under consideration.

YIELD AND PHYSICAL PROPERTIES OF THE OILS.

Two methods were used for the extraction of the flax samples, namely, ether extraction and cold expression. The former method was applied to determine the actual yield of oil in the seeds, while the method of cold expression was employed to obtain working samples of the various oils for the determination of the physical and

chemical constants. Ether extractions were made by means of the customary Soxhlet extractors, while a small laboratory hydraulic press served for the cold expression of the oil. The yields of oil given in all cases represent ether-extracted oils, whereas all physical and chemical properties were determined upon cold-pressed oils.

It must be borne in mind that these cold-pressed samples differ from ordinary commercial raw linseed oils, being obtained under entirely different conditions. The results obtained are therefore comparable with each other, but not with commercial linseed oils.

The color was carefully noted in each case. Considerable diversity appeared and the colors are described as well as possible in order to bring out the existing differences.

The specific gravity and the refractive index, being affected by the composition of the oils, were carefully determined. Both of these constants bear a certain relationship to the composition of the oil.

Table II was prepared to show the similarities and differences in yield and physical properties of the various oils examined. The yield of oil and physical properties are arranged according to the stations at which the several varieties of flax were grown. Each Cereal Investigations number of flax grown at any station is given, together with the yield of oil during the two years. This arrangement permits a comparison of the varieties grown at each station during the two successive seasons.

By a careful study of Table II it will be seen that the samples of flax bearing Cereal Investigations numbers grown at each station during either of the two years vary considerably in yield of oil. This variation is apparent at each of the stations. Since each of the numbers represents a different variety, the differences in the yield of oil may be attributed to the varieties. When the same variety as grown at widely separated stations shows differences in yield of oil it is probable that climatic and soil conditions play an important part.

In comparing the Cereal Investigations numbers of any one station during the two years, the yields of oil in many cases are distinctly comparable. While not constant, a certain degree of constancy is noticeable among them.

In order to make a better comparison of the Cereal Investigations numbers, not only at each station but at all the stations, the average oil yields were calculated and are included in Table II. A glance at the average yield of oil from the various Cereal Investigations numbers discloses those producing the highest and lowest yields at each station. It is noticed that Nos. 3 and 19 occupy a high position with regard to oil content, while Nos. 12 and 13 are usually low. The stations producing the highest and lowest oil yields are also clearly indicated in Table II.

TABLE II.—*Yield and physical properties of various oils from the flax crops of 1914 and 1915.*

[Color abbreviations: B=brown, d=deep, g=golden, l=lemon, p=pale, r=reddish, v=very, y=yellow.]

Station and C. I. No. of seed sample.	Yield of oil (per cent).			Color.		Specific gravity at 24° C.			Index of refraction at 24° C.	
	1914	1915	Average.	1914	1915	1914	1915	Average.	1914	1915
Moccasin, Mont.:										
No. 3	34.8	34.12	34.46	gy	pgy	0.9273	0.9283	0.9278	1.4770	1.4776
No. 12	32.5	33.00	32.70	ly	pgy	.9293	.9288	.9290	1.4776	1.4778
No. 13	33.0	34.50	33.75	gy	dly	.9268	.9305	.9286	1.4772	1.4784
No. 19	37.1	.....	37.10	gy	pgy	.9262	.9286	.9274	1.4782	1.4770
Seasonal average	34.35	33.87	.....	.....	.....	.9274	.9290			
Dickinson, N. Dak.:										
No. 3	36.8	37.03	36.91	pgy	vdgy	.9308	.9291	.9299	1.4808	1.4785
No. 12	34.6	33.00	33.80	dly	pgy	.9315	.9293	.9304	1.4806	1.4782
No. 13	31.4	32.20	31.80	vdly	vdgy	.9305	.9295	.9300	1.4802	1.4789
No. 19	35.3	37.10	36.20	dly	pb, r. tint.	.9302	.9289	.9290	1.4801	1.4782
Seasonal average	34.52	34.82	.....	.....	.....	.9307	.9292			
Mandan, N. Dak.:										
No. 3	34.0	33.80	33.9	pgy	vpg	.9280	.9298	.9289	1.4781	1.4790
No. 12	31.44	35.70	33.57	ply	vpgy	.9278	.9292	.9285	1.4790	1.4788
No. 13	33.24	34.72	33.98	dly	gy	.9285	.9300	.9292	1.4795	1.4790
No. 19	35.6	35.50	35.55	dly	pgy	.9274	.9301	.9287	1.4783	1.4787
Seasonal average	33.74	34.93	.....	.....	.....	.9279	.9298			
Newell, S. Dak.:										
No. 3	35.70	37.40	36.55	dgy	pgy	.9269	.9295	.9282	1.4765	1.4787
No. 12	30.30	37.20	33.75	dgy	vpgy	.9261	.9292	.9276	1.4760	1.4783
No. 13	32.10	31.80	31.45	pgy	vpgy	.9299	.9297	.9298	1.4782	1.4789
No. 19	33.80	36.84	35.42	pgy	pgy	.9270	.9288	.9279	1.4765	1.4780
Seasonal average	32.97	35.81	.....	.....	.....	.9274	.9293			
Highmore, S. Dak.:										
No. 3	33.99	34.56	34.27	vdgy	pgy	.9280	.9280	.9280	1.4780	1.4780
No. 12	33.42	36.00	34.71	pgy	vply	.9272	.9291	.9291	1.4780	1.4782
No. 13	33.20	34.44	33.82	pgy	pgy	.9277	.9287	.9282	1.4780	1.4780
No. 19	36.70	37.68	37.19	pgy	pgy	.9260	.9285	.9272	1.4773	1.4777
Seasonal average	34.32	35.67	.....	.....	.....	.9272	.9286			
Archer, Wyo.:										
No. 3	31.44	37.80	34.62	dgy	gy	.9279	.9309	.9294	1.4773	1.4796
No. 12	32.24	38.76	35.50	dly	pgy	.9267	.9309	.9288	1.4777	1.4792
No. 13	33.44	38.20	35.82	gy	pgy	.9277	.9315	.9296	1.4782	1.4796
No. 19	36.30	40.40	38.35	gy	pgy	.9283	.9318	.9300	1.4778	1.4795
Seasonal average	33.35	38.79	.....	.....	.....	.9276	.9312			
Burns, Oreg.:										
No. 3	35.38	34.84	35.11	gy	pgy	.9279	.9304	.9291	1.4790	1.4790
No. 12	32.40	33.40	32.90	pgy	pgy	.9280	.9294	.9289	1.4786	1.4787
No. 13	32.35	31.60	31.97	py	pgy	.9282	.9301	.9291	1.4780	1.4790
No. 19	37.10	33.20	35.15	py	pgy	.9275	.9299	.9287	1.4783	1.4786
Seasonal average	34.30	33.26	.....	.....	.....	.9279	.9299			

The color of the oils from the various flax samples, while primarily golden yellow, differed considerably in the depth of the shade, varying from a deep golden yellow bordering on brown to a very pale lemon yellow or straw color. Whether there is any existing relationship between the color and the quality of the oils can not be definitely stated, unless it is found that the color properties can be correlated with some of the more important physical and chemical properties.

The specific gravity is a property which bears a certain relationship to the composition and hence is more closely related to the quality of the oils. Table II shows considerable variation among the Cereal Investigations numbers at any station during either season. When compared according to stations, the specific gravity shows a tendency to be high or low in several locations during both seasons. When grouped and averaged according to the stations at which the flax was grown and according to the Cereal Investigations numbers, some striking comparisons, which will be discussed in later pages, are made possible.

In Table II the index of refraction is given for the various oils, along with the specific gravity, as a physical property which is subject to similar variation, according to the composition of the oils. It will be noted that in practically all cases where the specific gravity is high the index of refraction is also high.

The acid, saponification, and iodin values[1] of the oils from the several stations were determined, together with the drying tests, and the results are arranged for comparison in Table III.

In considering the acid value of the linseed oils it will be seen that there is not only considerable variation in the oils from the various Cereal Investigations numbers during each of the seasons at each station, but the same number at other stations shows similar differences. The differences among the numbers at any station during either year may be due to difference in the type and character of the plants, but differences shown by the same number at different stations can probably be attributed to varying conditions of the harvested seed, the weather conditions during harvest, and the method of harvesting and storing.

No definite relationship seems to exist in the acid values of various samples at any one station during the two years. Comparison of the average acidity of samples grown at the various stations during the two years shows the variability of the acid values. In most cases the acidity of the oils from the 1914 samples was much higher than from the 1915 samples.

The saponification value, which represents the sum total of the free acids and glyceryl esters in the oils, will be seen to bear a close relationship to the acid values. The average of the saponification values of the oils from each station was higher during 1914 than during 1915, which is likewise true of the average acid value of the same oils.

In considering the iodin values of the several samples it will be seen that there is considerable individual variation among the several

[1] Determinations of the chemical constants were made in accordance with the official and provisional method of analysis, Bureau of Chemistry Bulletin No. 107 (revised), 1910. The iodin values were obtained by means of the Hübl method, 4 hours being allowed in every case for the absorption of iodin. Complete iodin absorption doubtless did not take place in the above time. The results, however, serve well for the comparative purposes for which they are used.

varieties at any one station during either 1914 or 1915. Station averages are likewise variable during the two seasons. Some of the Cereal Investigations numbers are seen to possess fairly constant iodin values for the two years at particular stations, while others show some variation.

The iodin value, which depends upon the composition of the oil, is doubtless affected by conditions of season and growth.

TABLE III.—*Chemical properties and drying tests of various oils from the flax crops of 1914 and 1915.*

Station and C. I. No. of seed sample.	Acid value.			Saponification value.			Iodin value.			Time to dry (days).		
	1914	1915	Average.	1914	1915	Average.	1914	1915	Average.	1914	1915	Average.
Moccasin, Mont.:												
No. 3	0.78	0.60	0.69	191.0	188.7	189.8	156.6	156.2	156.4	18	14	16
No. 12	.79	.68	.73	189.3	192.8	191.0	156.0	153.5	154.7	18	10	14
No. 13	.83	.91	.87	192.4	189.7	191.0	159.3	154.0	156.6	18	10	14
No. 19	.79	.64	.71	191.4	186.6	189.0	159.2	155.0	157.1	14	15	14.5
Seasonal average	.797	.707	.....	191.0	189.4	.....	157.8	154.7	.....	17	12.2	.....
Dickinson, N. Dak.:												
No. 3	1.05	.81	.93	192.0	187.2	189.6	164.3	162.4	163.3	8	21	14.5
No. 12	.70	.85	.77	187.8	186.3	187.0	170.0	168.5	169.2	8	20	14
No. 13	.99	.86	.92	192.8	186.2	189.5	165.3	161.0	163.1	6	19	12.5
No. 19	1.36	.76	1.06	189.8	186.7	188.2	169.5	159.0	164.2	6	21	13.5
Seasonal average	1.025	.820	.....	190.6	186.6	.....	167.2	162.7	.....	7	20.2	.....
Mandan, N. Dak.:												
No. 3	1.11	.86	.98	192.5	199.8	196.1	164.3	160.7	162.5	10	20	15
No. 12	1.01	.95	.98	191.9	186.9	189.4	161.7	162.4	162.0	10	16	13
No. 13	1.04	.78	.91	190.2	187.0	188.6	162.4	163.3	162.8	10	18	14
No. 19	1.07	.55	.81	192.1	188.0	190.0	159.3	159.9	159.6	10	19	14.5
Seasonal average	1.057	.785	.....	191.7	190.4	.....	161.9	161.6	.....	10	18.2	.....
Newell, S. Dak.:												
No. 3	1.13	.67	.90	190.2	184.6	187.4	155.2	162.1	158.6	24	22	23
No. 12	1.11	.76	.93	191.4	185.9	188.6	154.0	159.5	156.7	26	22	24
No. 13	1.04	.74	.89	191.0	184.7	187.8	160.0	167.7	163.8	24	20	22
No. 19	1.00	.78	.89	188.7	187.7	188.2	161.8	158.0	159.9	20	20	20
Seasonal average	1.07	.737	.....	190.3	185.7	.....	157.7	161.8	.....	23.6	21	.....
Highmore, S. Dak.:												
No. 3	.93	.71	.82	195.6	187.9	191.7	162.0	160.3	161.1	23	18	20.5
No. 12	1.39	.74	1.06	193.6	187.9	190.7	157.7	161.4	159.5	21	12	16.5
No. 13	1.16	.55	.85	191.3	188.4	189.8	153.1	161.9	157.5	23	15	19
No. 19	1.66	.78	1.22	190.3	188.1	189.2	156.7	164.7	160.7	23	15	19
Seasonal average	1.285	.695	.....	192.7	188.1	.....	157.4	162.1	.....	22.5	15	.....
Archer, Wyo.:												
No. 3	.86	.90	.88	191.9	187.9	189.9	165.5	171.7	168.6	12	9	10.5
No. 12	.80	.93	.86	190.3	186.1	188.2	170.6	180.0	175.3	12	15	13.5
No. 13	.62	.90	.76	193.0	186.7	189.8	163.0	170.0	166.5	14	13	13.5
No. 19	.82	1.06	.94	182.3	186.9	184.6	167.5	165.5	166.5	9	12	10.5
Seasonal average	.775	.947	.....	189.4	186.9	.....	166.6	171.8	.....	11.7	12.2	.....
Burns, Oreg.:												
No. 3	.95	.44	.69	189.1	188.4	188.7	161.4	158.0	159.7	20	10	15
No. 12	1.03	.37	.70	190.7	185.0	187.8	167.8	158.4	163.1	18	10	14
No. 13	.90	.62	.76	192.4	187.3	189.8	160.1	160.3	160.2	18	8	13
No. 19	1.02	.60	.81	192.6	188.9	190.7	158.0	157.0	157.5	18	8	13
Seasonal average	.975	.507	.....	191.2	187.4	.....	161.8	158.4	.....	18.5	9	.....

In addition to the physical and chemical properties of the oils under discussion, the drying property, which is of importance, was deter-

mined in order to ascertain the relative rapidity with which the various oils dried to the customary film characteristic of drying oils.

The drying tests were conducted by spreading a thin film of oil over ground-glass plates 2 inches square and allowing the film to dry by exposure to the air, due precaution being taken to prevent the accumulation of dust on the surface. The experiments were conducted indoors at ordinary room temperature during the winter and early spring months.

Approximately the same weight (about 0.1820 gm.) of oil was used in every case, the oil spreading over an area of about 1½ square inches. The glass plates with the film of oil were weighed at definite intervals until no further increase in weight was observed, the time of complete drying being expressed in days. The average increase in the weight of all the oils varied from 12 to 14 per cent.

Comparison of the drying tests in Table III shows that certain Cereal Investigations numbers at different stations produce oils which dry more rapidly or more slowly than others.

Some stations show a close relationship among the Cereal Investigations numbers in the time of drying during the two seasons, while others show considerable variation in this respect. The effect of seasonal variation upon the composition of the oils at the stations is again evident.

A study of this nature admits of two general comparisons, namely, (1) a comparison of the several Cereal Investigations numbers and (2) a comparison of stations with respect to the oils produced during the two seasons.

In order that the data given in Tables II and III as related to the several Cereal Investigations numbers may be more readily compared, the yearly and general average yield, the specific gravity, the acid value, the iodin value, and the time of drying of the oils were computed and the results assembled in Table IV.

TABLE IV.—*Comparison of yield, specific gravity, acid value, iodin value, and time of drying of oils from the four flax varieties grown in 1914 and 1915.*

Seed sample.	Yield of oil (per cent).				Specific gravity.				Acid value.				Iodin value.				Time of drying (days).			
	Yearly average.		General average.	Rank.	Yearly average.		General average.	Rank.	Yearly average.		General average.	Rank.	Yearly average.		General average.	Rank	Yearly average.		General average.	Rank.
	1914	1915			1914	1915			1914	1915			1914	1915			1914	1915		
No. 3.....	34.59	35.65	35.11	2	0.9281	0.9297	0.9289	2	0.972	0.713	0.841	4	161.3	161.6	161.1	3	16.4	16.3	16.35	4
No. 12....	32.41	35.29	33.84	3	.9281	.9294	.9287	3	.975	.754	.861	2	162.5	163.4	162.9	1	16.1	15.0	15.57	3
No. 13....	32.67	33.92	33.22	4	.9284	.9300	.9292	1	.940	.765	.851	3	160.4	162.6	161.5	2	16.1	14.7	15.43	2
No. 19....	35.98	36.79	36.42	1	.9276	.9295	.9285	4	1.10	.738	.920	1	161.7	159.8	160.8	4	14.3	15.7	15.00	1

The yield of oil of the several Cereal Investigations numbers grown at all the stations during each season is strikingly constant. The relative position of each number with respect to the average yield of oil

during either season is identical. No. 19 produced the highest average yield, with No. 3 ranking second, followed in order by Nos. 12 and 13 during both seasons.

The annual average specific gravity of each Cereal Investigations number was lower in 1914 than in 1915. The ranking of the numbers with respect to specific gravity each year is very similar. Nos. 13 and 3 possess the same relative high specific gravity each year and in general average are followed closely by Nos. 12 and 19.

The 1914 oils were uniformly much higher in acid value than the 1915 oils. In general average C. I. No. 19 was highest in acidity, followed by Nos. 12, 13, and 3. Much less difference is noted in the yearly average of the iodin values of the several oils. No. 12 possessed the highest average iodin value during both years. No. 3 also occupied the same relative position during the two seasons. Arranged in decreasing order of their general average iodin value, the numbers rank as follows: 12, 13, 3, 19.

In general average of drying it will be seen that C. I. No. 19 dried the most rapidly, followed by Nos. 13, 12, and 3. This order was closely maintained during each season.

Constant differences appear to exist in the four varieties in some of the physical and chemical properties. Thus, C. I. Nos. 19 and 3 produced a constantly high yield of oil, while Nos. 12 and 13 produced a constantly low yield.

The specific gravity of C. I. No. 13 oils was constantly high at most of the stations during the period under observation, while No. 19 oils were low in comparison in most cases.

In acid value, C. I. No. 19 exceeded the other oils in most of the determinations during the two seasons. On the other hand No. 3 was constantly low in acid value.

Considerable difference was noted in the iodin values of the several oils at the several stations during the two seasons. C. I. Nos. 12 and 13 as a rule gave higher iodin values than Nos. 3 and 19, the latter being fairly constantly lower in this property.

C. I. No. 19 excelled the other samples in the time of drying, followed closely by Nos. 13 and 12, with No. 3 showing the slowest drying property during each year at nearly all of the stations.

The drying of the oil does not seem to be solely dependent upon any one property of the oil. Rapidity of drying apparently depends upon a combination of properties. Thus, an oil combining high iodin value with high acid value dries comparatively rapidly. Likewise, oils with high iodin values and high specific gravity also dry rapidly. Finally, oils combining high iodin values with high acidity and high specific gravity invariably dry very rapidly.

In order to compare the various stations or geographical sources of the flax varieties with respect to yield and properties of the oil, the

yearly averages and general averages were computed from the data given in Tables II and III, and the results are presented in Table V.

TABLE V.—*Comparison of yield, specific gravity, acid value, iodin value, and time of drying of oils from flax grown at seven different stations in 1914 and 1915.*

[The stations where the seed samples were grown are designated by numbers as follows: No. 1=Moccasin, Mont.; No. 2=Dickinson, N. Dak.; No. 3=Mandan, N. Dak.; No. 4=Newell, S. Dak.; No. 5=Highmore, S. Dak.; No. 6=Archer, Wyo.; No. 7=Burns, Oreg.]

Station.	Yield of oil (per cent).				Specific gravity.				Acid value.				Iodin value.				Time of drying (days).			
	Yearly average		General average.	Rank.	Yearly average.		General average.	Rank.	Yearly average.		General average.	Rank.	Yearly average.		General average.	Rank.	Yearly average.		General average.	Rank.
	1914	1915			1914	1915			1914	1915			1914	1915			1914	1915		
No. 1	34.35	33.87	34.11	6	0.9274	0.9290	0.9282	6	0.797	0.707	0.752	6	157.8	154.7	156.2	7	17.0	12.2	14.6	5
No. 2	34.52	34.82	34.67	3	.9307	.9292	.9299	1	1.025	.820	.922	2	167.2	162.7	164.9	2	7	20.2	13.6	2
No. 3	33.74	34.93	34.33	5	.9279	.9298	.9288	4	1.057	.785	.921	3	161.9	161.6	161.7	3	10	18.2	14.1	4
No. 4	32.97	35.81	34.39	4	.9274	.9293	.9283	5	1.070	.737	.903	4	157.7	161.8	159.7	5	23.6	21.0	22.3	7
No. 5	34.32	35.67	35.00	2	.9272	.9286	.9279	7	1.285	.695	.990	1	157.4	162.1	159.7	6	22.5	15.0	18.75	6
No. 6	33.35	38.79	36.07	1	.9276	.9312	.9294	2	.775	.947	.861	5	166.6	171.8	169.2	1	11.7	12.2	11.95	1
No. 7	34.30	33.26	33.78	7	.9279	.9299	.9289	3	.975	.507	.741	7	161.8	158.4	160.1	4	18.5	9.0	13.75	3

The results given in Table V show that the yield of oil from the groups of samples at the stations mentioned are for the most part fairly constant during the two seasons. The yield during 1914 was uniformly lower than in 1915 with two exceptions. Burns, Oreg., and Moccasin, Mont., averaged slightly higher in 1914 than in 1915.

The amount of precipitation at each station during the growing months in 1914 and 1915 is perhaps the most influential factor in affecting the yield of oil, since the proper growth and maturity of the flax plants are dependent largely upon the amount of moisture available to the plants. By consulting Table I it will be observed that the precipitation during the growing months in 1914 was less at all stations except one (Dickinson, N. Dak.) than in 1915. It is singular to note that when the greatest differences occurred in the yield of oil at these stations there was also the greatest difference in precipitation. Thus, samples from Newell, S. Dak., and Archer Wyo., gave much higher yields of oil in 1915 than in 1914. The precipitation at these stations during the growing months was likewise much greater in 1915 than in 1914.

The yield of oil from the samples from Moccasin, Mont., in 1914 (34.35 per cent) is but slightly higher than in 1915 (33.87 per cent). The precipitation during the growing months of these two seasons also shows but slight variation. Samples from Burns, Oreg., show a higher yield of oil in 1914 (34.30 per cent) than in 1915 (33.26 per cent). The precipitation was likewise greater in 1914 (4.27 inches) than in 1915 (2.90 inches).

It may therefore be stated that the yield of oil at any definite geographical locality as indicated by the results obtained at the seven stations specified is dependent largely upon the precipitation and evaporation at each station.

Arranging the stations in decreasing order of their oil yields, it is found that the Archer, Wyo., samples show the highest average yield of oil for the two seasons, followed by Highmore, S. Dak., Dickinson, N. Dak., Newell, S. Dak., Mandan, N. Dak., Moccasin, Mont., and Burns, Oreg. This ranking, in contrast to the results for different years, does not seem to be correlated to any extent with differences in precipitation between stations. Annual precipitation and evaporation and the nature of the soil in affecting the retention of moisture assume more importance in this connection. It may be noted also that the station with the highest average yield of oil (Archer, Wyo.) is the southernmost one (latitude 41° 42′).

The specific gravities as given in Table V, representing the average of all the Cereal Investigations numbers at each particular station, denote in a general way the density of the oils produced at a certain geographical locality.

The 1915 oils were almost without exception higher in specific gravity than during the previous year. The Dickinson, N. Dak., oils of 1914 and 1915 averaged the highest in specific gravity, while Archer, Wyo., and Burns, Oreg., followed in close order. Mandan, N. Dak., Newell, S. Dak., Moccasin, Mont., and Highmore, S. Dak., averaged considerably lower, the oils from Highmore, S. Dak., being conspicuously low, occupying the seventh position with respect to rank during both seasons. The oils from Moccasin, Mont., also occupied identical positions with respect to average low specific gravity, being sixth in order during the two years.

Certain of the stations were noticeably constant in producing oils of either high or low specific gravity during the two seasons. The generally lower specific gravities in 1914 may, like the yields of oil, be attributed to climatic and soil conditions.

The 1914 oils were higher in average acid value than the 1915 oils, no apparent constancy existing at any of the stations for the two years. The acid value, which is a measure of free acidity, fluctuates considerably among the several stations during each year. When the condition of the seed during harvest and subsequent storage is favorable, the liberation of free fatty acids takes place with rapidity.

The stations listed in the order of the decreasing acidity of their oils are as follows: Highmore, S. Dak., Dickinson, N. Dak., Mandan, N. Dak., Newell, S. Dak., Archer, Wyo., Moccasin, Mont., and Burns, Oreg.

The average iodin value of the oils from the various stations shows a certain relationship from year to year. Thus the Mandan, N. Dak., samples possessed nearly identical average iodin values during 1914

and 1915. Close relationship also existed in the Moccasin, Mont., and Burns, Oreg., samples. The Archer, Wyo., samples possessed high iodin values, occupying almost the same relative positions during both 1914 and 1915, as did also Dickinson and Mandan, N. Dak., while Highmore and Newell, S. Dak., and Moccasin, Mont., averaged constantly low.

In the time required for drying, a close relationship exists among several of the stations from year to year. The Archer, Wyo., samples show a comparatively uniform and short time for drying during both seasons. The Newell, S. Dak., oils required a uniformly longer time for drying than those from any of the other States. In both of the stations there is a certain relationship between the drying property and the physical and chemical properties. Thus, the Archer, Wyo., samples dried the most rapidly of all. These oils also possessed the highest average iodin values, high specific gravities, and moderately high acid values. The Newell, S. Dak., samples, on the other hand, were the slowest in drying and likewise possessed comparatively low iodin value, specific gravity, and acidity. The Dickinson, N. Dak., samples, ranking next to those of Archer in rapidity of drying, combined high iodin and acid values with high specific gravity. The Highmore, S. Dak., samples, ranking next to those from Newell, S. Dak., in slow-drying properties, combined very low iodin values and specific gravities with high acidity. The Mandan, N. Dak., samples, ranking fourth in drying property, combined medium-low iodin and acid values with low specific gravity, while the Moccasin, Mont., samples, ranking fifth in drying property, also combined very low iodin and acid values with low specific gravity. The same relationship appears, therefore, to exist between the drying property and the physical and chemical properties of the oils, when compared from the station standpoint, as exists when comparing the varieties at the several stations.

RELATION OF THE OILS TO THE SOURCE OF SEED.

Discussing the relation of geographical source to yield of oil it may be stated that while some variation occurs from year to year at any one locality, due largely to climatic conditions, certain stations may be said to produce flax showing higher average yields of oil than others. The Archer, Wyo., Highmore, S. Dak., and Dickinson, N. Dak., samples produced relatively high average oil yields, followed by those from Newell, S. Dak., and Mandan, N. Dak., while the Moccasin, Mont., and Burns, Oreg., samples produced relatively low yields during the two years under observation.

It is very probable from the results shown that the yield of oil from the various flax varieties is dependent to a certain extent upon the geographical location with the varying conditions of soil and climate.

With regard to the physical properties of the oils it will be seen that in most cases the station averages differ considerably from year to year.

A relationship appears to exist between specific gravity and color, the oils with the highest specific gravity being invariably lighter in color.

No relationship appears to exist between the acid value of the oils and the station at which they are produced. This is to be expected when it is considered that the acidity of an oil is due perhaps more to conditions of harvesting, handling, and storage of the seed than to agricultural factors.

The iodin values as well as the drying tests of the oils, from the standpoint of the stations, bear about the same relationship as the specific gravities. Since the iodin value is due to certain constituents in the oil, this particular property is doubtless influenced very much by the growth of the plants, which in turn is affected by the location of stations and changed climatic conditions.

The yields of oil from the different flax varieties varied considerably. Some varieties maintained comparatively high average yields during the two seasons under observation. The variability of the oil yields may be attributed to varietal differences in the plants in conjunction with conditions of growth and season.

It appears that certain of the Cereal Investigations numbers, such as Nos. 19 and 3, grown at the several stations during two successive seasons yielded constantly high percentages of oil. The other varieties, Nos. 12 and 13, show constantly low yields of oil.

Distinct differences are also noted in the specific gravities of the oils from the several varieties under consideration. Nos. 13 and 3 averaged higher than Nos. 12 and 19.

A marked fluctuation in acidity is noticed among the various Cereal Investigations numbers, no apparent relationship existing between them. The iodin values, on the other hand, bear a definite relationship to the Cereal Investigations numbers. Nos. 12 and 13 maintained high average iodin values, while Nos. 3 and 19 averaged somewhat lower from year to year. In the drying tests the varieties which show a tendency to dry rapidly or slowly are dependent to a large extent upon a combination of high iodin value with high specific gravity or high acid value.

CONCLUSIONS.

In conclusion, it may be stated that the results of the investigation show that varieties of flax possessing agronomic differences also differ in both the physical and chemical properties of the oils. Varieties possessing certain properties maintain these properties to a marked degree from season to season. From these results it may

be assumed that the climatic and soil conditions existing at the respective localities acted in conjunction in a similar manner from year to year in affecting the growth and development of the plant.

The yields of oil were found to vary with the variety of flax as well as with the locality in which it was grown. Thus, certain Cereal Investigations numbers gave constantly high or low yields of oils during the two years, and certain stations yielded flax samples with constantly high or low content of oil.

The physical properties, specific gravity, index of refraction, and color are apparently quite variable in many instances and are not so easily correlated with variety or locality.

A direct relationship appears to exist between the drying property of the oils and the specific gravity, acid value, and iodin value. Oils combining high acidity with high specific gravity and possessing a relatively high iodin value invariably dried to a firm film most rapidly. The relationship between the drying property and the color of the oils was also very marked. The lightest colored oils invariably possessed the most rapid drying properties.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 656

Contribution from the Bureau of Chemistry
CARL L. ALSBERG, Chief

Washington, D. C. ▲ May 8, 1918

CONCORD GRAPE JUICE: MANUFACTURE AND CHEMICAL COMPOSITION.

By B. G. Hartmann, *Fermentation Chemist*, and L. M. Tolman, *Chief, Central Food and Drug Inspection District.*[1]

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SCOPE OF THE INVESTIGATION.

Although a large amount of work has been done on the chemical composition of American grapes, and several bulletins on the subject have been issued in the last few years by the Department of Agriculture, the information presented is restricted principally to the acid and sugar content of American grapes, and, in the main, is of interest to viticulturists only. The literature appears to contain no specific information concerning the manufacture and chemical composition of commercial Concord grape juice. The purpose of the investigation, the results of which are embodied in this bulletin, was to obtain information on the manufacture of Concord grape juice and to procure chemical data on authentic samples of this product.

The first step of the work consisted in taking, under the supervision of a member of the Bureau of Chemistry, 5-gallon samples

[1] It is desired to express appreciation, for their cooperation, to Mr. B. B. Wilcox, who was in charge of the work conducted at the factory in the Hudson River district, and to Mr. M. J. Ingle, who assisted in the chemical analysis of the juices.

of regular factory juices. Some of these samples were analyzed immediately, and the others were sealed, placed in the storage vaults of the respective factories, and allowed to remain there with the regular factory juices until the bottling season, when they were bottled in the presence of a chemist, under the prevailing factory conditions, and shipped to Washington for chemical analysis. A comparison of these two sets of analyses shows the changes in chemical composition which take place during the storage period.

The work was extended over a period of three years, during which time several hundred samples were taken and analyzed. The principal factories in the State of New York were chosen for study because the great bulk of Concord grape juice is manufactured in this State. One representative of the Bureau of Chemistry was sent to Ulster County in the Hudson River district, in the eastern part of the State, and one to Chautauqua County, in the Chautauqua district, in the western part of the State. Of the five New York factories visited, four are located in the Chautauqua and one in the Hudson River district. Later the Lake Erie district, in the State of Ohio, was included. The report covering the investigation in this district is given separately, because of the decided difference in the process of manufacture. Laboratories were equipped and maintained during the pressing seasons, one factory in each of the districts being selected for the purpose.

CHARACTER OF FRUIT USED.

The Concord grape is a variety of *Vitis labrusca* L. It is one of the few black grapes which come well recommended as a standard grape. It is a midseason variety, and this fact in itself is reason enough for its extensive cultivation, since it is less liable to frost damage than the later varieties.

A grape which deserves mention as a rival for grape-juice manufacturing purposes is the Clinton. The Clinton, which belongs to the *Vitis riparia-x-labrusca*, lacks the foxy flavor of the Concord. It is very productive and carries more sugar than the Concord. The Clinton is exceedingly hardy, even more so than the Concord, and thrives on soils and under conditions not so favorable to the Concord. The color of the juice is a rich red, and the berry, although somewhat smaller in size than that of the Concord, is juicy and vinous. This variety is not extensively grown at present.

The Concord grape is very juicy, of medium acidity, and the juice has a rich red color. It is very hardy and productive, and, mainly for these reasons and because of its color, it has become the favorite for the manufacture of red grape juice.

On the whole, the grapes used during the investigation in the various factories were of good quality. The grapes of the seasons

of 1913 and 1914 were slightly better than those of 1912 in sugar content and general maturity. It is natural that there should be more or less variation in sugar content, even in fruit from the same locality, since it is obvious that the nature of the soil, the location and drainage of the vineyard, and the manner of cultivation have a very decided effect upon sugar formation. Table 1 shows this variation in solids and alcohol content of six samples of grapes produced in different sections of the Chautauqua belt.

TABLE 1.—*Variation in solids and alcohol content of Concord grapes from different sections of the Chautauqua belt.*

Section.	Condition of grapes.	Solids per 100 cc.	Sugars as invert before inversion per 100 cc.	Non-sugar solids per 100 cc.	Alcohol per 100 cc.
		Grams.	*Grams.*	*Grams.*	*Grams.*
Silver Creek	Well ripened	19.08	17.02	2.06	0.06
Fredonia	Fairly well ripened	20.81	18.72	2.09	.06
Portland	Well ripened	19.89	17.87	2.02	.06
Forsyth	do	19.31	17.30	2.01	.06
Irving	do	16.44	14.15	2.29	.06
Ripley	Overripe	18.50	15.98	2.52	.12

The samples represented the average from several crates taken from deliveries to the factory. All samples were in good condition and similar in appearance. The juices were cold hand pressed. Table 1 shows a variation of about 4.5 grams of sugar per 100 cubic centimeters. The sample from the Irving section, although of good appearance, had a flat, insipid taste, and was low in acid. The sample from Ripley showed signs of shriveling, and contained a small amount of damaged berries.

While the greater part of the fruit was received in wagonlots directly from the farmers, some was received in refrigerator cars. Generally speaking, shipments made in cars were very satisfactory, no particular damage to the grapes resulting when loaded carefully. In one case a shipment was in transit a week, and showed no signs of deterioration of any kind, the grapes being in good condition when unloaded at the factory. Occasionally, however, upon opening a car a distinct odor of fermentation was perceptible. In such cases crushed and moldy fruit, due to overfilling of the crates, was found to be present in appreciable amounts. Alcohol determinations on samples taken from these cars showed surprisingly low amounts of this ingredient.

A great number of alcohol determinations were made on grapes of varying quality. It was found that good, sound fruit contains only small amounts of alcohol, varying from 0.02 to 0.07 gram per 100 cubic centimeters of juice. That sound fruit should be low in alcohol

is self-evident, since yeasts can not penetrate the sound normal skin of the grape. Only in cases where the juice has been exposed through injury to the berry, as in the case of crushed or detached berries, is it possible for alcohol to form. Under such conditions the alcohol content may be as high as 0.3 gram per 100 cubic centimeters of juice. To prove this point the alcohol content of two samples of the poorest grapes obtainable was determined. The berries were badly crushed and covered with mold. These juices showed 0.22 and 0.27 gram of alcohol per 100 cubic centimeters.

To ascertain the effect of standing on the development of alcohol in grapes, a box of fruit was allowed to stand at room temperature, and the fruit analyzed for alcohol from time to time. The fruit was of good quality, only slightly damaged.

TABLE 2.—*Alcohol content of Concord grapes.*

	Grams per 100 cc.
Fresh grapes	0.02
After standing:	
48 hours	.08
72 hours	.09
96 hours	.10

After standing 96 hours the grapes had a dead, dull appearance, and had begun to shrivel.

These experiments are of more than average interest because they show that with careful handling grapes do not develop alcohol to any extent, and that only in cases of great damage is the alcohol content as high as 0.30 gram per 100 cubic centimeters. This fact is of importance to the juice manufacturer because grapes must often stand several days before they can be pressed.

It is evident, therefore, that damage from alcoholic fermentation is highly improbable with grapes of good quality, and that even the poorest fruit seldom contains more than appreciable amounts of alcohol. Far more serious is the presence of mold in grapes, because the juice made from fruit so infested may acquire an unpleasant, musty odor. In order to avoid such a condition, the producer is warned against filling the crates too full, and, wherever it is necessary to hold the grapes any length of time, to store them in such a manner that air can circulate freely throughout the stacks.

MANUFACTURE OF COMMERCIAL CONCORD GRAPE JUICE.

The grapes should be well matured and of the best quality obtainable. Immature fruit or green grapes yield juices of inferior quality because of high acidity, lack of sufficient sugar and color, and the presence of large amounts of green coloring matter. The well-matured grapes are gathered in wooden crates of about 25 pounds capacity, and are either crushed immediately or air-ripened. Some

difference of opinion as to the merits of these procedures exists. Careful air-ripening, however, mellows the fruit, develops flavor, and admits of a better condition for the process of juice manufacture than can be attained by using freshly picked fruit. For air-ripening it is of the utmost importance that the boxes of fruit be stacked in a cool place in such a manner that air may circulate freely throughout the stack. This precaution should not be overlooked; otherwise a rise in temperature may cause molding of the fruit. Overfilling the crate should be carefully guarded against to avoid crushing, with resultant souring of the fruit and possible fermentation. With proper care grapes may be kept for several days without particular harm to the fruit.

A desirable arrangement for a grape-juice factory is one which allows the product to fall from one operation to the next by gravitation. In this way unnecessary pumping is avoided, the metallic surface offered to the pulp or juice is reduced to a minimum, and the work of keeping the juice lines sweet and clean facilitated.

As to the effect of metals on the quality of the juice, experience has shown that aluminum offers more resistance to the acid of the juice and affects the color less than other base metals. Other metals, such as copper and tin, have been tried. Tin gives the juice a bitter metallic taste and a bluish tinge, and consequently affects the quality materially. Iron also affects the quality of the juice, giving it a purple tinge. It was found that when bottled the product of one of the factories included in this investigation showed a purple ring immediately on the surface. The cause of this ring was traced to the use of iron coils and pipes, which resulted in the formation of iron tannate.

The gravity plan entails the conveying of the fruit to the highest point in the system; that is, to the first unit in the chain of operations, the crusher. In some factories the fruit is washed in order to remove foreign matter such as dust and leaves before it is crushed. For this purpose the grapes are dumped into a tank of running water, in the bottom of which an endless belt is operated to remove the grapes from the water, and after proper draining convey them to the crusher.

The process of juice manufacture may be divided into six distinct manipulations:

1. Crushing and stemming the fruit.
2. Heating the crushed fruit.
3. Pressing the heated fruit.
4. Sterilizing and bottling the juice for storage.
5. Siphoning the juice.
6. Bottling and pasteurizing the trade juice.

CRUSHING AND STEMMING THE FRUIT.

The crusher consists of two rollers of metal, usually bronze, revolving at high speed. The rolls are set in such a manner as to avoid the crushing of the stems and seeds. The stemmer is a cylindrical revolving drum, inside of which are arranged revolving fingers that separate the berries from the stems. The crushed berries and liberated juice pass through openings in the side of the drum and fall through to the cooker, while the stems are pushed out of the drum by the fingers.

HEATING THE CRUSHED FRUIT.

From the stemmer the crushed fruit and the liberated juice fall into the heating kettles, commonly called cookers.

The grape berry may be divided into two main parts, the skin and the pulp. The pulp of the grape is practically colorless and carries most of the juice. The skin furnishes the coloring matter so much desired by the manufacturer of Concord grape juice, as well as less desirable ingredients. The juice of the pulp is sweet and pleasant but lacks body and character. The juice from the skin is highly colored, high in acid and tannin, and in mineral ingredients and body, but low in sugar. By judiciously mixing these two juices a better product, of more pleasing appearance, is obtained than would result from either of these juices alone.

Such a modified juice is obtained by the simple operation of heating the crushed fruit to suitable temperatures. The very closest attention is required, however, to secure the best results. Temperatures which are too high give the juice a harsh taste, lacking in quality but high in coloring matter, and if carried to excess may ruin the flavor and aroma completely. On the other hand, low temperatures do not draw sufficient color, and such juices are wanting in body, though pleasant in taste and aroma.

In choosing the best temperature for heating the crushed fruit, the quality of fruit must be taken into consideration. Ripe fruit or fruit that has been air-ripened yields its desirable ingredients at a lower temperature than immature fruit. Also the pressing process must be considered in connection with the heating, as by applying more or less pressure the color, tannin content, and body of the juice may be regulated, the greater pressure giving the more color, tannin, and body to the juice, as well as delivering the greater amount of juice. It is apparent that to regulate the tannin content and the body of a juice by using a smaller amount of pressure, means a loss of juice. Consequently it is better to regulate the heating process and not rely altogether upon the pressing process to correct the quality of the juice. In this connection it should be said that

although low temperatures during heating are very desirable for attaining quality, higher temperatures give a better dissolution of the fruit and a better yield of juice. As is evident from what has just been said, it is not possible to fix a definite temperature for the heating process. The temperature, however, should be between 135° and 150° F. The time required for heating is simply the time necessary to heat to the desired temperature.

By the heating of the crushed fruit the skins are drawn upon for color and body. A cold-pressed juice lacks the body and color of the hot-pressed juice, so this may be said to be the character-forming step. The effect of heating upon the chemical composition of the pressed juice may be seen by a comparison of the data given in Table 3, which shows the chemical composition of juices pressed from the heated and unheated fruit.

To obtain the cold-pressed juice a well-mixed sample of the pulp from the stemmer was pressed by hand through several thicknesses of cheesecloth and filtered through cotton. This gave the sample mentioned in Table 3 under the heading "Before heating." The same batch of pulp was again sampled after it had been heated to 150° F. in the cooker and the juice expressed in the same manner. This gave the sample in Table 3 under the heading "After heating."

Table 4 summarizes the results given in Table 3, and shows the increases in the various ingredients caused by heating the pulp.

TABLE 3.—*Chemical composition of hot and cold pressed Concord grape juices.*

Experiment.	Juice pressed before or after heating.	Solids, per 100 cc.	Sugar as invert before inversion, per 100 cc.	Non-sugar solids, per 100 cc.	Total acid as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Ash, per 100 cc.	Alkalinity of soluble ash, N/10 acid, per 100 cc.	Alkalinity of insoluble ash, N/10 acid, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Tannin and coloring matter, per 100 cc.
		Gms.	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Cc.*	*Cc.*	*Gms.*	*Gms.*	*Gms.*
1	Before	17.20	14.36	2.84	0.78	0.63	0.26	30.0	3.0	0.14	0.56	0.08
	After	17.83	14.58	3.25	1.12	1.04	.46	55.8	4.8	.13	1.05	.24
2	Before	16.33	13.88	2.45	.74	.63	.27	33.2	2.8	.09	.62	.07
	After	17.25	13.62	3.63	1.01	.97	.43	52.4	4.0	.12	.99	.19
3	Before	16.10	13.74	2.36	.84	.61	.20	22.4	3.6	.22	.42	.06
	After	17.17	13.74	3.43	1.16	1.01	.33	49.2	4.4	.21	.93	.20
4	Before	16.57	14.32	2.25	.75	.55	.22	25.2	2.8	.13	.47	.....
	After	18.50	15.12	3.38	1.10	.98	.39	44.0	4.0	.26	.83	.....
5	Before	15.66	13.38	2.28	.80	.65	.22	24.4	2.6	.24	.46	.....
	After	16.44	13.29	3.15	1.07	.96	.33	38.0	3.8	.33	.71	.....
6	Before	16.28	13.91	2.37	.79	.57	.23	26.0	3.6	.13	.49	.....
	After	17.41	13.83	3.58	1.09	.94	.37	41.2	4.4	.26	.77	.....

TABLE 4.—*Maxima, minima, and averages of data given in Table 3: Chemical composition of hot and cold pressed Concord grape juices.*

Juice pressed before or after heating.	Solids, per 100 cc.	Sugar as invert before inversion, per 100 cc.	Nonsugar solids, per 100 cc.	Total acid as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Ash, per 100 cc.	Alkalinity of soluble ash, N/10 acid, per 100 cc.	Alkalinity of insoluble ash, N/10 acid, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Tannin and coloring matter, per 100 cc.
Maximum:	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Cc.*	*Cc.*	*Gms.*	*Gms.*	*Gms.*
Before	17.20	14.36	2.84	0.84	0.65	0.27	33.2	3.6	0.24	0.62	0.08
After	18.50	15.12	3.63	1.16	1.04	.46	55.8	4.8	.33	1.05	.24
Minimum:											
Before	15.66	13.38	2.25	.74	.55	.20	22.4	2.6	.09	.42	.06
After	16.44	13.29	3.15	1.01	.94	.33	38.0	3.8	.12	.71	.19
Average:											
Before	16.36	13.93	2.43	.78	.61	.23	26.9	3.1	.16	.50	.07
After	17.43	14.03	3.40	1.09	.99	.39	46.7	4.2	.22	.88	.21
Average increase.	1.07	.10	.97	.31	.38	.16	19.8	1.1	.06	.38	.14

Table 4 shows very plainly that during the heating process the juice acquires more body, acid constituents, and color. The increase in acidity, which is very marked, is due chiefly to the presence of cream of tartar and small amounts of other organic acids, principally malic and tannic. The increase in nonsugar solids is due to pectin substances and gums, coloring matter, and the organic acids just mentioned and their salts. These various increases are due to the behavior of the skin of the grape berry during the heating process.

During the storing period the quantity of cream of tartar derived through the heating process is largely eliminated through precipitation (Tables 7 and 8), so that the stored juice contains approximately the same amount of this ingredient as is contained in the cold-pressed juice. During the storage of the juice, part of the pectin substances and gums and part of the tannin and coloring matter are removed from the juice. With the decrease in cream of tartar during storage there is a corresponding decrease in total solids, nonsugar solids, total acidity, total tartaric acid, ash, and the alkalinity of the water-soluble ash.

The heating kettles are of aluminum and are steam-jacketed. Steam-jacketed, glass-lined steel tanks, or wooden vats fitted with aluminum steam coils, may, however, be employed with success. The heating kettles, or vats, are equipped with agitators to allow uniform heating of the pulp. That thorough agitation while heating the crushed fruit is of the utmost importance is self-evident, since to allow the mass to rest would overheat the portion next to the heating surface and cause scorching. Scorching also results from filling the kettles while hot. These two precautions should be closely observed in order to avoid a cooked taste in the juice.

From the heating kettles the fruit is dropped to the press room, where it is made up into cheeses and pressed.

PRESSING THE HEATED FRUIT.

The hot pulp is enveloped in strong, coarse-meshed cloths to form layers which are stacked on top of one another. These stacks or "cheeses," as they are called, are then subjected to pressure. The height of the stacks varies in different factories. It may be said, however, that low cheeses are to be preferred to high ones, because they allow a better yield of juice on account of the greater elasticity of the higher cheeses.

The presses used in the factories are of two types, the hydraulic or power press and the screw or wine press. The number of layers varies with the size and power of the press, and the size of the layers themselves. As a rule, 10 layers (48 by 48 inches) constitute a cheese. While the cheese is being prepared and the number of layers increases, the pressure on the cheese grows, thereby increasing the flow of juice. This flow of juice is called the free-run juice, since it is the juice which is recovered by the weight of the cheese itself without additional pressure. This juice is lighter in color than the juice obtained after pressure is administered, and is practically the juice from the pulp proper. It is materially lower in acid and has less tannin and body than the final juice after the pressing process is completed. The free run amounts to about 56 per cent of the entire quantity of available juice in the fruit. Before the pressure is applied the cheese should be allowed to settle. This settling period is of importance, as it allows the coarse particles of pulp gradually to shift with the flow of juice to the sides of the cloths, followed up by finer material; thus a very efficient filter for the juice is provided. If the pressure were applied without allowing the cheese to settle, the advantage due to the collection of this filtering material and its consequent clarifying effect would be sacrificed. Although obviously advantageous to allow the cheese to settle before applying pressure, it is not absolutely necessary. It is evident, however, that the greater the amount of suspended matter removed from the juice before it is bottled for storage the better will be the precipitation so far as compactness is concerned, an advantage not to be underestimated because of the better conditions for siphoning. Although the time allowed for the settling of the cheese varies in the different factories, 15 minutes is quite sufficient for this operation. This is shown in figure 1. The first 10 minutes served to build the cheeses. The time of settling was varied to show the effect of time upon the recovery of free-run juice. Table 5 gives the data shown in figure 1.

TABLE 5.—*Amount of juice recovered as free run and under pressure.*

Kind of juice.		Experiment 1.	Experiment 2.
1. Juice delivered during cheese making	per cent	33	36
2. Total free-run juice	do	57	55
3. Juice delivered at low pressure	do	33	28
4. Juice delivered at high pressure	do	10	17
5. Juice recovered per ton of pulp	gallons	183	193
Total amount of free run, 80 per cent is recovered during cheese making and in the first 15 minutes after the cheese is prepared.			

It is evident that the greater part of the total available juice of the fruit exists in the free state, and that it requires but little pressure to recover from 83 to 90 per cent of the entire yield.

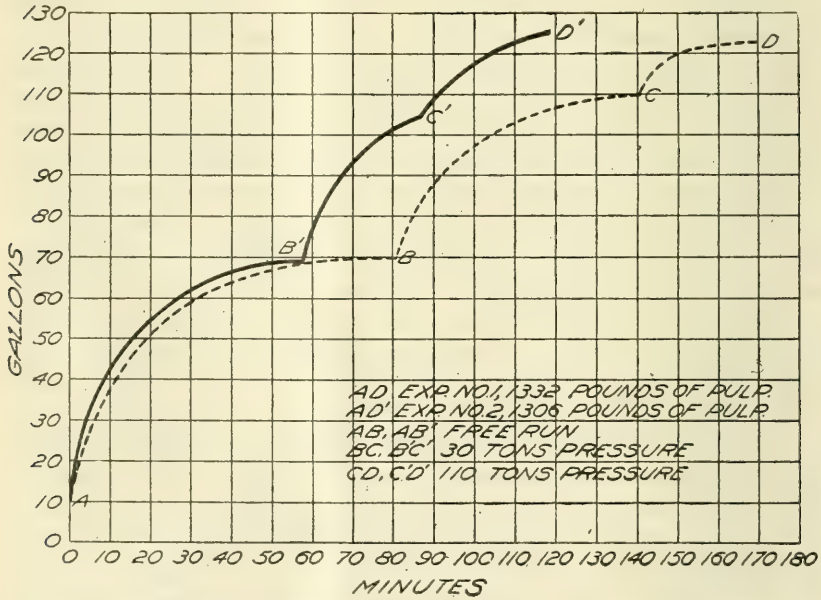

FIG. 1.—Relation between time allowed for settling and amount of free-run juice recovered.

Figure 1 shows that after 25 minutes—a 10-minute cheese-making and 15-minute settling period—in Experiment 1, 56 gallons of juice out of 70 gallons, the total amount of the free run, is recovered, or 80 per cent; and in Experiment 2, 58 gallons out of 69, or 84 per cent, is recovered. This proves that a 15-minute settling period is sufficient to recover more than 80 per cent of the juice obtainable by settling or free run.

After the cheese has settled, pressure is gradually applied and increased until it reaches about 100 tons, figured on a 10-inch ram, or about 2,546 pounds per square inch on the ram. The manner of increasing or holding the pressure varies in different factories. In

the majority, however, the time allowed for the pressing is about one hour, including the 35 minutes for reaching high pressure of 100 tons, and 25 minutes at high pressure, so that the entire pressing from the time the first layer is made through the settling period to the time the pressure is released occupies about one hour and 25 minutes.

Table 6 shows the differences in composition of the juices obtained at various pressures.

TABLE 6.—*Chemical composition of Concord grape juices obtained at various pressures.*

Pressure.	Experiment.	Time.	Solids, per 100 cc.	Sugars as invert before inversion, per 100 cc.	Non-sugar solids, per 100 cc.	Ash, per 100 cc.	Total acid as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Tannin and coloring matter, per 100 cc.
		Min.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Free run	1	15	16.62	13.48	3.14	0.410	1.11	0.99	0.27
	2		16.78	13.36	3.42	.....	1.04	.99	.26
0 to 25 tons	1	15	17.30	13.82	3.48	.....	1.20	1.01	.28
	2		16.91	13.34	3.57	.....	1.17	1.06	.28
25 to 75 tons	1	15	17.48	13.86	3.62	.....	1.25	1.04	.31
	2		.....	.....	.....	.....	.....	.....	.....
75 to 100 tons	1	5	17.41	13.88	3.53	.....	1.25	1.07	.33
	2		16.78	13.07	3.71	.....	1.28	1.15	.29
Drainings at 100 tons	1	25	17.48	13.66	3.82	.484	1.27	1.12	.36
	2		16.73	12.93	3.80	.....	1.31	1.17	.32

The data in Table 6 were obtained on hydraulic presses with 10-inch rams. The pulp was heated to about 150° F. and made into cheeses consisting of 10 layers, each 48 by 48 by 3 inches. The completed cheese was allowed to settle for about 15 minutes under the weight of the piston head. The juice expressed in this manner, which is termed "free run," amounted to about 65 per cent of the total available juice. Pressure was then applied, and gradually brought up to 100 tons; from 0 to 25 tons in about 15 minutes; from 25 to 75 tons in about 15 minutes; from 75 to 100 tons in about 5 minutes. At 100 tons the pressure was held about 25 minutes, so that the total time of pressing after the cheese was prepared was about 1 hour and 15 minutes.

The data are self-explanatory. They show that as the pressure increases the juice becomes more fullbodied and richer in color and acid ingredients.

After the cheese has been allowed to drain at high pressure the pressure is released. The residue in the cloths, called the pomace, amounts to about 15 per cent of the heated fruit. A pomace which has been subjected to 100 tons pressure is dry and tough. It contains, on an average, about 60 per cent moisture and 40 per cent

of solids. The dried pomace contains about 20 per cent sugar and about 4 per cent of acid as tartaric. The pomace remaining in the cloths is removed by shaking the cloths. In order to insure the life of the cloths, it is advisable to wash them each time they are used. In some factories where screw presses are employed the cloths are not washed oftener than every fourth time of using. After the cloths have been washed they are centrifuged or passed through a wringer to remove the excess of moisture, and are ready for use again. In one factory the washed cloths are dried by blowing hot air through them.

STERILIZING THE JUICE AND BOTTLING IT FOR STORAGE.

After having been strained through several thicknesses of burlap to remove coarse particles, the juice flowing from the presses is united in the sterilizers. The sterilizers are aluminum vats, or kettles, and are steam-jacketed. In these the juice is heated to destroy the living organisms, so that it may keep during the precipitation period. If the juice, just as it runs from the presses, were filled into the precipitation vessels, it would ferment in a very short time.

The temperature to which the juice is subjected in the sterilizing process is of the utmost importance to the flavor and aroma. The effect of operations carefully conducted during the earlier stages of the manufacturing process may be completely destroyed by carelessness during sterilization. This pertains not only to the temperature employed during sterilization, but also to the manner in which the kettles are filled. As in the process of heating the pulp, care must be taken not to run the juice into a hot kettle, because this would scorch the juice and give it a cooked taste. All kettles should be filled at a low temperature and then heated. This rule applies to every process in which the juice is heated. The sterilizing temperature varies in the different factories, ranging from 176° to 190° F. It is, of course, evident that the lowest possible temperature affording thorough sterilization is the best. It is inadvisable, however, to go much lower than 180° F. on account of the danger of fermentation.

The precipitating vessels, glass carboys, or jugs of 5-gallon capacity are now filled to within a few inches from the top with the hot sterile juice. These have previously been heated in steam boxes for the purpose of sterilizing them and of allowing them to accommodate themselves gradually to the temperature of the juice they are to receive, this latter precaution being necessary to avoid breakage. As soon as the juice has been poured in, the vessels are closed with corks of good quality, prepared by dipping into heated paraffin to close up any pores or canals. The paraffining of the corks is a very important measure, as the contraction of the cooling juice would draw air through any space which might be left, causing mold or even fer-

mentation. The cleaning of glass carboys can be more easily supervised, and the siphon can be placed to better advantage in them than in jugs; the majority of factories therefore prefer the carboys. In selecting the carboys or jugs care should be taken that the mouth of the container has no defect and is as round as possible, so that the cork may fit tightly. Furthermore, in selecting glass carboys, vessels with perpendicular sides should be chosen in preference to those with sloping sides, because the former permit better settling of the lees or argols. To guard against possible fermentation through defects in the mouth of the vessels, it is a good plan to pour a small quantity of molten paraffin over the cork after it is in place, and allow the paraffin to solidify before transferring the containers to the vaults. The sealed vessels containing the sterile juice are placed in the vaults and allowed to remain undisturbed for several months, so that the juice may clarify and the excess of acid tartrates be thrown out. To obtain the best precipitation, the temperatures in the vaults should be kept as low as possible, i. e., as close to 32° F. as can be maintained without danger of freezing.

SIPHONING THE JUICE.

As cream of tartar is least soluble at low temperatures, the juice should be siphoned only during the winter months. At the close of the precipitation period, comprising from 4 to 5 months, the corks are drawn, and the clear juice siphoned into jugs. The siphon consists of an aluminum tube bent U shape, over one end of which a piece of rubber tubing of the desired length is drawn. The siphon is placed in the vessel just out of reach of the sediment, and gentle suction applied at the rubber end until the juice starts to flow. The sediment remaining in the precipitation vessels is poured on several thicknesses of burlap stretched on a frame, and the juice allowed to drain. This juice, which is thick and muddy on account of small crystals of cream of tartar and other material, is again treated in the sterilizer, and poured into carboys in the same manner as the juice proper, and again stored for precipitation and subsequent siphoning. This juice, called "seconds," is mixed with the first siphoned juice. The residue on the burlap, called "argols," consists chiefly of acid salts of tartaric acid.

Experiments conducted by manufacturers for the purpose of clarifying the juice during the precipitation period with the white of egg and gelatin have met with little or no success. This failure is to be expected, in consideration of the fact that heated grape juice contains pectins and gummy substances, and that the juice itself has a very marked viscosity. Of course, it is always possible to remove the suspended matter by filtration, but this is a very tedious operation, and it is doubtful whether it is worth the trouble.

During the storage period the juice passes through a number of important changes. The hot juice when placed in the carboy has a beautiful bright red color. As it cools it becomes turbid, and the color takes on a brownish tint. The hot juice is full-bodied and has a harsh acid taste. The stored juice has a reddish-brown color, is more or less muddy, and has a pleasant taste and aroma. The loss in acidity during storing is due chiefly to the crystallizing of acid salts of tartaric acid. These salts are soluble to the extent of about 0.6 gram per 100 cubic centimeters in the stored juice; consequently any amount of them contained in a juice in excess of 0.6 gram will be precipitated.

To determine the amount of material precipitated during storing, the sediment contained in a carboy, which had been in storage about one year and shipped from Chautauqua County, N. Y., to Chicago, Ill., by express, was collected, dried, and weighed. It was found to amount to 0.42 gram per 100 cubic centimeters of juice.

With the precipitate a part of the tannin and coloring matter is thrown down; consequently the resultant juice has a milder, more pleasant, and decidedly less acid taste.

Table 7 gives a comparison of the analyses of 22 juices, comprising 11 sets, half of which were analyzed at the time of storing and half after 4 months' storage.

The juices marked "Before" are the fresh juices taken while hot from the sterilizing kettles, and those marked "After" are the same juices after having been stored about 4 months. The differences in composition are striking. In Table 8 the material given in Table 7 is condensed to show the maxima, minima, and averages of the two sets of juices, and the average losses of the various ingredients during the storing period.

Table 8 shows a number of interesting facts. There is a substantial decrease in solids during storing, about one-half of which is accounted for by the precipitation of cream of tartar and earth alkali tartrates. The other half is probably due to the precipitation of pectin bodies and gums. There is no material difference between the sugar contents of fresh and stored juice. With the precipitation of cream of tartar other ingredients, such as tannin and coloring matter, earth alkali tartrates, and gums and pectins, come down. The precipitation of cream of tartar is also attended by a definite decrease in nonsugar solids, total acids, total tartaric acid, and the alkalinity of the ash. While the amounts of the constituents vary in the case of the fresh juices, they seem to have approached an equilibrium in the stored juices. This is especially true of the cream of tartar.

TABLE 7.—*Chemical composition of Concord grape juice at time of storing and after 4 months' storage.*

Analysis before or after storage.	Solids, per 100 cc.	Alcohol, by volume.	Sugars as invert, before inversion, per 100 cc.	Sugars as invert, after inversion, per 100 cc.	Nonsugar solids, per 100 cc.	Total acid as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Ash, per 100 cc.	Alkalinity soluble ash, N/10 acid, per 100 cc.	Alkalinity insoluble ash, N/10 acid, per 100 cc.	Tannin and coloring matter, per 100 cc.
	Grams.	*P. ct.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Cc.*	*Cc.*	*Gms.*
Before	17.01	1.03	13.25	13.38	3.76	1.26	0.99	0.30	0.72	0.34	38.4	7.6	0.26
After	16.41	1.07	13.34	13.47	3.07	1.10	.72	.28	.47	.22	24.8	4.4	.19
Before	16.99	.64	13.55	13.60	3.44	1.11	.88	.26	.64	.34	33.8	7.6	.17
After	16.41	.70	13.58	13.45	2.83	1.01	.69	.24	.49	.24	25.8	4.4	.13
Before	17.01	.....	13.95	13.99	3.06	1.08	1.03	.24	.85	.44	45.2	7.2	.28
After	16.62	.07	13.80	13.89	2.82	.95	.78	.23	.60	.30	32.0	4.6	.21
Before	17.59	.....	14.45	14.60	3.14	1.08	.97	.24	.77	.39	40.8	7.6	.20
After	17.17	.09	14.50	14.41	2.67	1.02	.84	.27	.63	.32	33.6	4.4	.16
Before	18.50	.....	15.11	15.15	3.39	1.07	1.02	.31	.74	.37	39.6	8.0	.19
After	17.69	.06	14.99	14.95	2.70	.92	.69	.19	.54	.27	28.6	4.6	.17
Before	19.76	.....	16.39	16.55	3.37	1.04	1.00	.24	.80	.39	42.8	7.6	.20
After	19.18	.10	16.15	16.30	3.03	.91	.75	.27	.53	.29	28.0	3.8	.18
Before	17.35	.....	13.97	14.05	3.38	.98	.90	.13	.81	.39	43.2	8.0	.15
After	16.47	.13	13.87	13.82	2.60	.83	.65	.13	.57	.31	30.4	4.4	.13
Before	18.48	.14	15.07	15.11	3.41	1.25	.85	.15	.73	.37	39.0	8.0	.26
After	17.95	.23	15.02	15.13	2.93	1.07	.66	.22	.50	.24	26.6	3.0	.22
Before	17.84	.58	14.32	14.49	3.52	1.27	.97	.17	.86	.40	45.6	8.0	.24
After	17.33	.69	14.32	14.30	3.01	1.07	.58	.14	.49	.24	26.0	3.4	.17
Before	18.08	.....	14.70	14.74	3.38	1.22	.89	.19	.76	.37	40.4	6.4	.22
After	17.85	.23	14.88	14.84	2.97	1.08	.67	.22	.50	.27	26.4	3.4	.17
Before	18.50	.....	15.10	15.21	3.40	1.22	.90	.15	.80	.38	42.8	7.2	.27
After	18.22	.10	15.26	15.21	2.96	1.09	.70	.21	.55	.27	29.0	3.6	.20

TABLE 8.—*Maxima, minima, and averages of data given in Table 7: Changes in chemical composition of Concord grape juice resulting from 4 months' storage.*

	Solids, per 100 cc.	Sugar as invert, before inversion, per 100 cc.	Sugar as invert, after inversion, per 100 cc.	Nonsugar solids, per 100 cc.	Total acid as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Ash, per 100 cc.	Alkalinity soluble ash, N/10 acid, per 100 cc.	Alkalinity insoluble ash, N/10 acid, per 100 cc.	Tannin and coloring matter, per 100 cc.
Before:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Cc.*	*Cc.*	*Grams.*
Maximum	19.76	16.39	16.55	3.76	1.27	1.03	0.31	0.86	0.44	45.6	8.0	0.28
Minimum	16.99	13.25	13.38	3.06	.98	.85	.13	.64	.34	33.8	6.4	.15
Average	17.92	14.54	14.62	3.38	1.14	.94	.21	.77	.39	41.1	7.5	.22
After:												
Maximum	19.18	16.15	16.30	3.07	1.10	.84	.28	.63	.32	33.6	4.6	.22
Minimum	16.41	13.34	13.45	2.60	.83	.58	.13	.47	.22	24.8	3.0	.13
Average	17.39	14.52	14.52	2.87	1.01	.70	.22	.53	.27	28.3	4.0	.18
Average loss	.53	.02	.10	.51	.13	.24	—.01	.24	.12	13.0	3.5	.04

A hot grape juice represents a supersaturated solution of cream of tartar. As the juice in the carboy cools, the cream of tartar crystallizes until the solution is reduced to the point of saturation. This

change from the supersaturated to the saturated condition is very gradual, so that the time allowed for the precipitation has a decided effect upon the amount of cream of tartar retained in solution. This is shown in Table 9, wherein it will be noticed that the cream of tartar content has diminished during the additional one year of storage. Shaking a grape juice hastens the precipitation of cream of tartar, and brings about an equilibrium much more rapidly than simply allowing the juice to stand undisturbed. It seems therefore that the process of manufacture could be shortened, if after a few days' storing the juice were given a thorough shaking, and then allowed to stand for the rest of the storage period. It also seems reasonable to believe that this extra manipulation would give a much brighter finished product.

TABLE 9.—*Chemical composition of Concord grape juice after 4 months' storage and after 16 months' storage.*

Storage period.	Solids, per 100 cc.	Alcohol by volume.	Sugar as invert, before inversion, per 100 cc.	Sugar as invert, after inversion, per 100 cc.	Nonsugar solids, per 100 cc.	Total acid as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Ash, per 100 cc.	Alkalinity soluble ash, N/10 acid, per 100 cc.	Alkalinity insoluble ash, N/10 acid, per 100 cc.	Tannin and coloring matter, per 100 cc.
Months.	*Gms.*	*Perct.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Cc.*	*Cc.*	*Gms*
4	17.43	0.07	14.45	14.40	2.98	0.95	0.68	0.15	0.58	0.31	31.0	4.2	0.16
16	17.48	.07	14.60	14.70	2.88	.94	.67	.20	.51	.25	27.0	4.6	.14
4	16.47	.13	13.87	13.82	2.60	.83	.65	.13	.57	.31	30.4	4.4	.13
16	16.47	.14	14.00	13.98	2.47	.83	.60	.16	.49	.26	25.8	3.8	.12
4	17.85	.05	14.42	14.36	3.43	1.10	.82	.27	.58	.35	30.8	5.8	.26
16	17.80	.07	14.54	14.64	3.26	1.06	.72	.28	.41	.26	21.6	7.6	.20
4	19.00	.07	15.70	15.77	3.30	1.11	.69	.28	.43	.23	23.0	4.4	.33
16	19.10	.07	15.90	15.95	3.20	1.14	.65	.27	.35	.22	18.6	7.0	.16
4	18.53	.06	15.06	15.06	3.47	1.13	.83	.33	.54	.28	28.8	4.6	.33
16	18.48	.07	15.20	15.30	3.28	1.10	.70	.31	.38	.22	20.0	6.0	.16
4	18.79	.13	15.48	15.68	3.31	1.13	.79	.29	.55	.30	29.0	4.4	.22
16	18.80	.07	15.60	15.58	3.20	1.14	.66	.28	.36	.23	19.4	6.2	.17
4	17.85	.07	14.30	14.43	3.55	1.19	.88	.37	.56	.34	30.0	4.2	.32
16	17.80	.07	14.55	14.49	3.25	1.20	.80	.41	.38	.24	20.0	6.0	.17
4	18.95	.20	15.47	15.41	3.48	1.09	.75	.22	.56	.31	29.6	6.0	.32
16	18.87	.13	15.64	15.64	3.23	1.10	.68	.26	.41	.25	21.8	6.0	.17
Maximum:													
4	19.00	.20	15.70	15.77	3.55	1.19	.88	.37	.58	.35	31.0	6.0	.33
16	19.10	.14	15.90	15.95	3.28	1.20	.80	.41	.51	.26	27.0	7.6	.20
Minimum:													
4	16.47	.06	13.87	13.82	2.60	.83	.65	.13	.43	.23	23.0	4.2	.13
16	16.47	.07	14.00	13.98	2.47	.83	.60	.16	.35	.22	18.6	3.8	.12
Average:													
4	18.11	.10	14.84	14.87	3.27	1.07	.76	.26	.55	.30	29.1	4.8	.26
16	18.10	.09	15.00	15.04	3.10	1.06	.69	.27	.41	.24	21.8	5.9	.16
Average loss	.01	.01	.....	.....	.17	.01	.07	.....	.14	.06	7.3	.....	.10

Small amounts of alcohol have a decided effect on the general clarification of a juice, lowering the viscosity and insuring a better precipitation of cream of tartar. Table 11, group 2, shows that

stored juices containing the least alcohol have a higher cream of tartar content than those with greater amounts of alcohol. It seems improbable, however, that the small amounts of alcohol contained in the juices in question could be solely responsible for this difference in cream of tartar content.

Table 9 gives a comparison of the analyses of 16 juices, comprising 8 sets, half of which were analyzed after 4 months' storage and half after 16 months' storage. Each two lines of data in the table represent a sample of the regular juice bottled after 4 months' storing, and the same juice after an additional storing of 1 year. Although the difference is very marked in the case of the ash and tannin content, it is not very pronounced in the other contents. The data show that 4 months of storing is not a sufficient time for complete precipitation.

BOTTLING AND PASTEURIZING THE TRADE JUICE.

The next step is that of pasteurizing the juice in the bottle. This operation should be very carefully superintended because any defect leads to fermentation and consequent loss. The pasteurizing temperature varies in the different factories, ranging from 160° to 175° F. As a rule, when the bottles are filled cold, the juice reaches the pasteurizing temperature in about 10 minutes, is allowed to remain at pasteurizing temperature for about 30 minutes, and cooled off in 10 minutes. When filled hot, from 20 to 25 minutes at pasteurizing temperature are sufficient. The length of the heating period varies with the size of the package to be sterilized, 55 minutes sufficing with pint and quart containers. Packages holding more than a quart should be filled hot.

The siphoned juice is strained through several thicknesses of burlap, and collected in a vat connected with the filling machines. The practice of filtering the juice through paper pulp, employed in some factories, did not seem to improve the appearance of the juice very much. The packages are filled with the juice by means of beer fillers, and immediately sealed, either with corks or metallic seals. When corks are used it is necessary to heat the juice before bottling to avoid blowing. A temperature of about 160° F. is ordinarily used for this. When metallic seals are used for smaller packages it is not necessary to heat the juice before filling them. Packages holding more than a quart should, however, be filled hot to avoid breakage.

MANUFACTURE OF GRAPE JUICE IN THE LAKE ERIE DISTRICT.

The method of manufacture of the juices from the Lake Erie district differed greatly from the methods which have been described. The grapes were not stemmed before heating, and the juice was

stored for precipitation in barrels instead of in 5-gallon containers. For the most part, grapes grown on the Bass Islands, in Lake Erie, to the north of Sandusky, Ohio, were used in the preparation of the juices. The fruit, which was of good quality, was immediately crushed and heated without being stemmed. The pulp was heated in aluminum kettles to about 145° F., and pressed on hydraulic presses in the customary manner. The juice was strained through several thicknesses of burlap, heated in glass-lined kettles to about 175° F., after which it was run into 50-gallon barrels, previously sterilized by steam. The barrels were filled to the tops with the hot juice, and immediately carefully bunged. After having been stored for precipitation, the juice was run into the trade packages and sterilized in the customary manner.

OCCURRENCE OF SMALL AMOUNTS OF ALCOHOL.

Under usual factory conditions it is impossible to produce juices which are wholly free from alcohol. Grapes are carriers of yeast cells, and the juice itself is an ideal medium for yeasts. Moreover, the temperatures attained during the latter part of the pressing process are very favorable to conditions yielding alcoholic fermentation. Then again, as the pressing season advances, the press beds, racks, press cloths, and floors of the factory become thoroughly impregnated with vigorous yeast cells. The danger from alcoholic fermentation is still further increased by the fact that the yeast cells brought in on the grapes to the air of the factory assist in starting fermentation wherever conditions of temperature are favorable.

Special care was taken to discover the causes for the occurrence of small amounts of alcohol occasionally found in commercial grape juices. One possible cause is undoubtedly the fermentation in the fruit itself. As has been shown, however, grapes of good quality contain such small amounts of alcohol that this source may be disregarded. The principal cause must, therefore, be sought in the manufacturing process. Tables 7 and 9 show that the alcohol content does not increase in the precipitation vessel during storage. Improper methods of pasteurization might, of course, cause fermentation in the trade package, but alcoholic fermentation, once started, would proceed very rapidly until it finally destroyed the package.

A very definite development of alcohol was found to occur during the pressing period in one establishment. Alcohol was distinctly discernible by odor, and toward the end of the pressing frothing set in. Samples of the material were taken at the various pressing stages and analyzed for alcohol. Table 10 shows the results thus obtained.

TABLE 10.—*Percentage of alcohol by volume in a particular Concord grape juice at various stages of pressing.*

Stage.	Experiment 1.	Experiment 2.
Heated pulp	0.08	0.09
First of free run	.80	.66
Last of free run	1.36	1.56
Last of low pressure at 30 tons	.86	1.60
Last of high pressure at 110 tons	2.06	2.60
Composite of juice	.60	.75

The total time consumed by the pressing period, including the settling period, was 2 hours and 50 minutes. The figures show a normal alcoholic content for the pulp, and an increased alcoholic content as the cheese cools.

From the tables of composition it is seen that of the 104 samples of juices recorded 44 per cent show 0.10 per cent or less of alcohol by volume; 77 per cent show 0.20 per cent or less of alcohol by volume; 83 per cent show 0.30 per cent or less of alcohol by volume; 90 per cent show 0.40 per cent or less of alcohol by volume. The remaining 10 per cent of the samples show an alcoholic content ranging from 0.40 to 1.07 per cent by volume.

It is interesting to note that all of the samples showing more than 0.40 per cent of alcohol are members of group 2, season 1912. In the manufacture of these juices the settling period was materially longer than that usually allowed. The juices of the seasons 1913 and 1914 of the same group, in the preparation of which a shorter settling period was used, show a decidedly lower content of alcohol. It is evident then that the danger period of alcoholic development is confined to the time allowed for the pressing of the juice, and that this danger may be reduced to a minimum by reducing the time for this part of the process.

INTRODUCTION OF WATER DURING MANUFACTURE.

A small amount of water is introduced into the juice during the process of manufacture. The stages at which the water may enter are (1) washing the grapes, (2) washing the press cloths, (3) washing receptacles, such as kettles, vats, carboys, and vessels. Although a great many experiments were conducted to determine the amounts of water in the finished product due to these additions, no definite results were obtained.

It is evident that the washing of grapes introduces water into the juice. The amount depends upon the time the grapes remain in the water, and upon the manner in which the washed grapes are drained. Experiments to determine the amount of water retained by the grapes showed that 2.5 per cent is held, or for 1 ton of grapes about

6 gallons of water would be introduced. Although only approximate, it is believed that this figure gives a fair representation of the true condition. The content in solids was invariably slightly lower in the case of juice made from grapes which had been washed than in the case of juice from grapes which had not been washed. It was found that about 6 pounds of water was retained in the washed and centrifuged cloths of standard size for 48 by 48 inch racks.

Experiments were conducted to determine the amount of water introduced by washing the grapes and washing the press cloths. Runs wherein the grapes were washed, and washed and centrifuged cloths were used, and runs wherein the grapes were not washed and new dry cloths were used, were made. Although a slightly heavier juice was obtained under the latter conditions, the difference was not great enough to allow of definite conclusions.

Judging from all the experiments and from the chemical composition of the juices, made with and without the use of water, it is believed that about 3 grams of water per 100 cubic centimeters are introduced into the juice during the washing and pressing of the grapes. The amount of water added during the washing of the receptacles is regulated by factory practice.

CHEMICAL COMPOSITION OF GRAPE JUICE.

The analyses of the 104 commercial juices taken during the investigations are given in Table 11. This material is divided into six groups, each group representing the juices from one factory. Group 1 comprises the samples from the Hudson River district. The first 15 samples represent juices made from washed grapes, the remainder those from unwashed grapes. The settling period was about 15 minutes. Groups 2, 3, 4, and 5 comprise the samples from the Chautauqua belt. The grapes of group 2 were washed. During the seasons 1914 and 1915 the time allowed for the settling of the cheese before pressing was shortened to about 25 minutes. Groups 3, 4, and 5 are juices made from unwashed grapes. The settling period was about 15 minutes. Group 6 comprises the juices made from grapes of the Lake Erie district. For the description of the manufacturing process see page 4. The 1912 samples of group 2 are not included in Table 11, because the alcohol content of this set is abnormally high for a properly prepared grape juice.

TABLE 11.—*Chemical composition of Concord grape juices.*

Group and season.	Solids, per 100 cc.	Alcohol by volume.	Sugars as invert, before inversion, per 100 cc.	Sugars as invert, after inversion, per 100 cc.	Non-sugar solids, per 100 cc.	Polarizations, normal weight, 200 mm. tube.			Total acidity calculated as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Ash, per 100 cc.	Alkalinity of water-soluble ash, N/10 acid, per 100 cc.	Alkalinity of water-insoluble ash, N/10 acid, per 100 cc.	Tannin and coloring matter, per 100 cc.
						Direct at 20° C.	Invert at 20° C.	Invert at 87° C.								
	Grams.	*Per cent.*	*Grams.*	*Grams.*	*Grams.*	*° V.*	*° V.*	*° V.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Cc.*	*Cc.*	*Grams.*
Group 1.																
1912	14.20	0.07	11.52	11.41	2.68	4.3	4.4	1.0	0.87	0.59	0.15	0.47	0.25	25.2	4.4	0.19
	15.55	.09	13.00	13.18	2.55	4.9	4.9	1.1	.94	.72	.19	.59	.28	31.2	4.2	.07
	15.63	.04	13.04	13.08	2.59	4.9	4.9	1.0	.95	.69	.20	.55	.27	29.4	3.6	.11
	14.72	.07	11.66	11.66	3.06	4.5	4.5	1.0	1.09	.82	.24	.65	.30	34.8	4.2	.18
	15.37	.13	12.67	12.58	2.70	4.8	4.8	1.4	1.01	.63	.15	.53	.28	28.0	3.8	.17
	15.81	.08	13.20	13.19	2.61	5.2	5.1	1.4	.88	.68	.19	.53	.26	28.2	4.6	.18
	14.98	.08	12.21	12.26	2.77	4.6	4.6	1.2	1.00	.64	.20	.48	.25	25.6	4.0	.15
	15.03	.10	12.38	12.24	2.65	4.8	4.7	0.8	.96	.65	.20	.47	.26	25.0	5.0	.16
	15.35	.07	12.51	12.36	2.84	4.8	4.9	1.0	1.08	.73	.19	.60	.30	32.0	3.8	.16
	15.71	.07	12.54	12.65	3.17	5.0	5.0	1.0	1.01	.76	.21	.61	.30	32.6	4.4	.18
	16.62	.07	13.80	13.89	2.82	5.6	5.6	1.0	.95	.78	.23	.60	.30	32.0	4.6	.21
	16.02	.07	13.19	13.30	2.83	5.0	5.1	1.0	.92	.73	.22	.57	.30	30.2	4.2	.22
	16.75	.06	13.52	13.52	3.23	5.3	5.4	1.2	1.03	.82	.19	.71	.37	37.7	4.2	.22
	17.17	.09	14.50	14.41	2.67	5.9	5.8	0.9	1.02	.84	.27	.63	.32	33.6	4.4	.16
	16.07	.04	12.87	12.80	3.20	5.0	5.1	1.0	1.07	.86	.26	.67	.34	35.6	4.6	.21
	16.36	.06	13.64	13.74	2.72	5.6	5.5	1.2	.81	.60	.12	.52	.28	27.8	4.4	.17
	16.28	.13	13.41	13.46	2.87	5.8	5.7	1.6	.95	.66	.21	.52	.27	27.4	3.2	.20
	16.68	.07	13.98	13.86	2.70	5.8	5.8	1.0	.91	.62	.16	.50	.26	26.4	4.0	.18
	16.70	.06	13.99	13.92	2.71	5.9	5.8	1.4	.89	.67	.19	.51	.25	27.2	4.8	.18
	17.43	.10	14.62	14.60	2.81	6.2	6.2	1.6	.91	.79	.27	.56	30	30.0	4.6	.19
	17.69	.06	14.99	14.95	2.70	6.1	6.2	1.2	.92	.69	.19	.54	.27	28.6	4.6	.17
	19.18	.10	16.15	16.30	3.03	6.7	6.5	1.0	.91	.75	.27	.53	.29	28.0	3.8	.18
	16.69	.13	13.76	13.96	2.93	6.1	6.0	1.4	.99	.79	.27	.56	.29	29.8	4.8	.18
	17.43	.07	14.45	14.40	2.98	6.3	6.3	1.2	.95	.68	.15	.58	.31	31.0	4.2	.16
	16.47	.13	13.87	13.82	2.60	6.0	6.0	1.0	.83	.65	.13	.57	.31	30.4	4.4	.13
Group 2:																
1912	17.80	.04	14.62	14.68	3.18	5.7	5.8	1.0	.97	.76	.17	.63	.31	33.6	6.0	.13
	18.22	.10	15.26	15.21	2.96	5.9	5.9	1.0	1.09	.70	.21	.55	.27	29.0	3.6	.20
	17.85	.23	14.88	14.84	2.97	5.9	5.8	1.8	1.08	.67	.22	.50	.27	26.4	3.4	.17
	17.95	.23	15.02	15.13	2.93	6.0	5.9	1.2	1.07	.66	.22	.50	.24	26.6	3.0	.22
	17.90	.36	15.04	14.88	2.86	6.5	6.5	1.8	1.04	.68	.24	.48	.26	25.6	3.8	.19
	17.18	.37	14.31	14.44	2.87	5.8	5.8	1.2	1.10	.71	.26	.47	.25	25.2	5.0	.20
	17.64	.40	14.80	14.70	2.84	6.0	5.9	1.6	1.04	.60	.14	.49	.24	26.0	4.4	.15
	16.28	.80	13.14	13.06	3.14	5.6	5.5	1.0	1.10	.65	.23	.44	.22	23.2	4.6	.19
	17.33	.69	14.32	14.30	3.01	6.0	6.1	1.4	1.07	.58	.14	.49	.24	26.0	3.4	.17

TABLE 11.—*Chemical composition of Concord grape juices*—Continued.

Group and season.	Solids, per 100 cc.	Alcohol by volume.	Sugars as invert, before inversion, per 100 cc.	Sugars as invert, after inversion, per 100 cc.	Non-sugar solids, per 100 cc.	Polarizations, normal weight, 200 mm. tube.			Total acidity calculated as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Ash, per 100 cc.	Alkalinity of water-soluble ash, N/10 acid, per 100 cc.	Alkalinity of water-insoluble ash, N/10 acid, per 100 cc.	Tannin and coloring matter, per 100 cc.
						Direct at 20° C.	Invert at 20° C.	Invert at 87° C.								
	Grams.	*Per cent.*	*Grams.*	*Grams.*	*Grams.*	*° V.*	*° V.*	*° V.*	*Grams.*	*Grams.*	*Grams.*	*Grams*	*Grams.*	*Cc.*	*Cc.*	*Grams.*
Group 2—Continued.																
1912	16.41	1.07	13.34	13.47	3.07	5.9	5.8	1.0	1.10	.72	.28	.47	.22	24.8	4.4	.19
	16.39	.77	13.54	13.54	2.85	5.9	5.8	1.2	1.02	.69	.23	.48	.25	25.4	5.0	.17
	16.05	.98	13.26	13.18	2.79	5.8	5.8	1.0	1.04	.66	.24	.45	.23	24.0	4.2	.16
	17.62	.70	14.76	14.67	2.86	6.2	6.2	1.2	1.07	.75	.32	.45	.23	23.8	4.8	.17
	16.73	.57	13.88	13.75	2.85	6.0	5.9	1.0	1.08	.68	.26	.44	.23	23.2	5.0	.18
	16.41	.70	13.58	13.45	2.83	5.8	5.9	1.2	1.01	.69	.24	.49	.24	25.8	4.4	.13
	17.38	.82	14.36	14.32	3.02	6.3	6.4	1.8	1.07	.73	.29	.49	.25	25.8	3.4	.19
	17.35	.20	14.61	14.58	2.74	6.1	6.2	1.4	.98	.65	.10	.58	.30	31.0	5.5	.18
	17.95	.53	14.81	14.73	3.14	6.3	6.2	1.4	1.11	.84	.29	.62	.31	33.0	3.8	.21
1913	18.76	.33	15.89	15.95	2.87	7.0	7.0	1.4	.92	.62	.19	.45	.24	24.0	4.4	.16
	18.27	.23	15.53	15.55	2.74	6.6	6.5	1.0	.94	.64	.19	.49	.24	26.0	4.2	.16
	17.80	.33	14.80	14.88	3.00	6.3	6.3	1.7	.99	.64	.22	.45	.23	23.8	4.2	.16
	19.08	.14	15.89	15.82	3.19	6.7	6.6	1.7	1.04	.74	.18	.63	.29	33.4	4.0	.17
	18.95	.10	15.88	15.96	3.07	6.3	6.4	1.2	1.05	.74	.16	.61	.30	32.2	6.8	.18
	18.90	.23	16.09	16.18	2.81	6.4	6.4	1.2	.94	.62	.13	.50	.26	26.8	5.6	.15
1914	19.05	.12	16.57	16.53	2.48	6.2	6.2	1.3	.99	.81	.30	.54	.26	28.6	5.6	.17
	19.71	.11	17.04	16.98	2.67	6.3	6.3	1.4	.98	1.01	.36	.70	.32	37.2	5.8	.15
	18.63	.16	16.18	16.14	2.45	6.1	6.2	1.2	.98	.75	.22	.55	.27	29.4	6.2	.14
	19.29	.02	16.69	16.72	2.60	6.2	6.3	1.3	.99	.88	.19	.79	.34	42.0	4.0	.16
Group 3:																
1912	18.66	.13	15.65	15.50	3.01	5.9	6.0	1.6	1.16	.73	.24	.52	.32	27.6	5.2	.24
	18.90	.13	15.70	15.79	3.20	6.2	6.2	1.4	1.01	.67	.20	.47	.28	25.2	6.4	.30
	18.79	.13	15.63	15.64	3.16	6.0	6.0	1.4	1.05	.66	.20	.46	.28	24.4	6.2	.31
	19.81	.13	16.51	16.64	3.30	6.8	6.7	1.4	1.05	.62	.22	.41	.23	22.0	4.8	.30
	19.44	.26	16.05	15.99	3.39	6.7	6.6	1.5	1.09	.70	.27	.43	.24	23.0	5.6	.30
	18.95	.20	15.63	15.73	3.32	6.2	6.2	1.4	1.13	.68	.26	.43	.25	23.0	4.8	.28
1913	19.29	.12	15.94	16.00	3.35	6.2	6.3	1.4	1.00	.68	.25	.45	.25	24.0	4.4	.32
	19.84	.13	16.59	16.56	3.25	6.5	6.5	1.4	1.09	.85	.36	.53	.28	28.0	5.0	.26
	20.52	.11	16.96	16.91	3.56	6.9	7.0	1.5	1.01	.72	.21	.55	.30	29.0	5.3	.34
	19.71	.20	16.39	16.48	3.32	6.5	6.4	1.0	1.05	.79	.31	.49	.25	26.0	6.0	.35
	20.26	.16	17.14	17.23	3.12	6.7	6.7	1.4	1.07	.73	.20	.51	.28	27.0	8.2	.22
1914	19.34	.03	16.79	16.83	2.55	6.2	6.2	1.5	1.03	.96	.26	.79	.37	42.0	4.7	.22
	19.34	.08	16.59	16.53	2.75	6.3	6.2	1.4	1.01	.90	.29	.68	.33	36.4	4.3	.26

Group 4:																
1912	17.93	.11	14.68	14.66	3.25	5.7	5.8	1.4	1.16	.74	.25	.51	.29	27.0	5.6	.30
	18.19	.04	14.91	14.80	3.28	5.5	5.4	1.3	1.23	.83	.23	.68	.34	36.0	4.0	.28
	18.53	.06	15.06	15.06	3.47	5.6	5.6	1.1	1.13	.83	.33	.54	.28	28.8	4.6	.33
	17.85	.05	14.42	14.36	3.43	5.4	5.5	1.1	1.16	.92	.28	.69	.35	36.8	5.8	.26
	19.00	.07	15.70	15.77	3.30	6.0	5.9	1.0	1.11	.69	.28	.43	.23	23.0	4.4	.33
	18.66	.07	15.67	15.68	2.99	6.0	6.2	1.2	1.04	.77	.24	.58	.29	30.6	5.0	.24
	19.60	.07	16.12	16.20	3.48	6.3	6.5	1.3	1.13	.79	.33	.49	.27	26.0	5.0	.29
	20.39	.13	17.09	17.05	3.30	6.8	6.8	1.2	1.08	.65	.23	.47	.26	25.2	3.1	.37
1913	20.78	.13	17.35	17.48	3.43	6.8	6.8	1.4	1.02	.62	.17	.47	.24	25.0	5.2	.36
	20.36	.10	16.77	16.80	3.59	6.6	6.7	1.4	.95	.56	.21	.38	.22	20.0	3.4	.35
	19.37	.10	16.15	16.18	3.22	6.5	6.4	1.6	1.04	.72	.26	.49	.27	26.0	4.4	.26
	20.07	.10	16.80	16.97	3.27	6.6	6.4	1.4	1.11	.56	.18	.36	.22	19.0	6.6	.32
	20.23	.07	17.05	17.16	3.18	6.7	6.6	1.4	1.01	.62	.19	.41	.24	22.0	6.8	.32
1914	18.92	.06	16.24	16.31	2.68	5.9	6.0	1.6	.99	.73	.24	.48	.26	25.6	7.0	.28
	19.36	.32	16.88	16.83	2.48	5.8	5.9	1.3	.99	.77	.33	.47	.23	25.0	4.6	.30
	19.39	.14	16.62	16.62	2.77	5.8	5.8	1.4	1.04	.80	.32	.50	.26	26.8	5.2	.33
Group 5:																
1912	17.88	.13	14.69	14.72	3.19	5.5	5.4	1.3	1.19	.86	.28	.64	.32	34.2	4.6	.23
	18.06	.07	15.00	15.02	3.06	5.9	5.9	1.4	1.28	.92	.27	.73	.36	39.0	4.4	.30
	18.22	.13	14.75	14.77	3.47	5.5	5.6	1.7	1.20	.81	.23	.64	.31	34.0	4.6	.34
	18.06	.07	14.45	14.56	3.61	5.5	5.6	1.6	1.13	.80	.23	.60	.32	32.0	6.2	.34
	17.85	.07	14.30	14.43	3.55	5.6	5.7	1.4	1.19	.90	.30	.67	.34	35.6	4.2	.32
	17.88	.13	14.30	14.40	3.58	5.9	5.8	1.4	1.13	.73	.23	.55	.32	29.0	4.4	.27
	18.95	.20	15.47	15.41	3.48	6.4	6.3	1.2	1.09	.75	.22	.56	.31	29.6	6.0	.32
	18.79	.13	15.48	15.68	3.31	6.3	6.4	1.6	1.13	.79	.29	.55	.30	29.0	4.4	.22
1913	18.97	.13	15.68	15.75	3.29	6.0	6.0	1.8	1.01	.65	.25	.41	.23	22.0	5.0	.34
	19.55	.16	16.36	16.48	3.19	6.7	6.8	1.2	.97	.59	.21	.38	.22	20.0	5.0	.31
	20.62	.20	17.28	17.37	3.34	7.0	7.0	1.6	.91	.63	.19	.46	.25	24.4	5.0	.30
	19.31	.13	15.71	15.81	3.60	6.3	6.4	1.6	1.08	.79	.31	.52	.28	27.6	4.2	.31
	19.94	.13	16.41	16.59	3.53	6.6	6.6	1.8	.95	.57	.20	.40	.22	21.0	3.8	.32
1914	19.16	.05	16.27	16.29	2.89	6.6	6.7	1.5	.98	.80	.22	.60	.31	32.0	6.4	.28
	20.02	.09	17.38	17.33	2.64	6.8	6.8	1.4	.98	.88	.21	.71	.34	37.8	6.8	.30
Group 6:																
1914	19.81	.09	17.06	16.93	2.75	6.2	6.3	1.5	.93	.82	.22	.62	.34	33.0	7.4	.18
	19.92	.05	16.88	16.79	3.04	6.3	6.3	1.4	1.01	.82	.27	.54	.34	28.8	8.0	.18
	20.39	.04	17.53	17.53	2.86	6.6	6.5	1.6	.96	.82	.28	.52	.32	27.4	8.8	.24
	19.05	.20	16.51	16.46	2.54	6.1	6.2	1.4	.91	.78	.26	.52	.31	27.8	6.8	.17
	19.65	.22	17.11	17.06	2.54	6.3	6.3	1.4	.87	.77	.26	.49	.29	26.0	7.8	.22
	19.23	.29	16.31	16.36	2.92	6.1	6.2	1.4	.91	.75	.25	.50	.30	26.8	6.6	.20
	19.60	.37	16.64	16.74	2.96	6.3	6.4	1.4	.90	.73	.29	.45	.30	23.8	5.6	.19
SUMMARY:																
Group 1—																
Max.	19.18	.13	16.15	16.30	3.23	6.7	6.5	1.6	1.09	.86	.27	.71	.37	37.7	5.0	.22
Min.	14.20	.04	11.52	11.41	2.55	4.3	4.4	0.8	.81	.59	.12	.47	.25	25.0	3.2	.07
Av.	16.24	.08	13.42	13.41	2.82	5.4	5.4	1.1	.95	.71	.20	.56	.29	29.9	4.3	.17
Group 2—																
Max.	19.71	.33	17.04	16.98	3.19	7.0	7.0	1.7	1.05	1.01	.36	.79	.34	42.0	6.8	.18
Min.	17.80	.02	14.80	14.88	2.45	6.1	6.2	1.0	.92	.62	.13	.45	.23	23.8	4.0	.14
Av.	18.84	.18	16.06	16.07	2.79	6.4	6.4	1.3	.98	.75	.21	.57	.28	30.3	5.1	.16

TABLE 11.—*Chemical composition of Concord grape juices*—Continued.

Group and season.	Solids, per 100 cc.	Alcohol by volume.	Sugars as invert, before inversion, per 100 cc.	Sugars as invert, after inversion, per 100 cc.	Non-sugar solids, per 100 cc.	Polarizations, normal weight, 200 mm. tube.			Total acidity calculated as tartaric, per 100 cc.	Total tartaric acid, free and combined, per 100 cc.	Free tartaric acid, per 100 cc.	Cream of tartar, per 100 cc.	Ash, per 100 cc.	Alkalinity of water-soluble ash, N/10 acid, per 100 cc.	Alkalinity of water-insoluble ash, N/10 acid, per 100 cc.	Tannin and coloring matter, per 100 cc.
						Direct at 20° C.	Invert at 20° C.	Invert at 87° C.								
SUMMARY—continued.	*Grams.*	*Per cent.*	*Grams.*	*Grams.*	*Grams.*	*° V.*	*° V.*	*° V.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Cc.*	*Cc.*	*Grams.*
Group 3—																
Max.	20.52	.26	17.14	17.23	3.56	6.9	7.0	1.6	1.16	.96	.36	.79	.37	42.0	8.2	.35
Min.	18.66	.03	15.63	15.50	2.55	5.9	6.0	1.0	1.00	.62	.20	.41	.23	22.0	4.3	.22
Av.	19.45	.19	16.27	16.29	3.17	6.4	6.4	1.4	1.06	.75	.25	.52	.28	27.5	5.4	.29
Group 4—																
Max.	20.78	.32	17.35	17.48	3.59	6.8	6.8	1.6	1.23	.92	.33	.69	.35	36.8	7.0	.37
Min.	17.85	.04	14.42	14.36	2.48	5.4	5.4	1.0	.95	.56	.17	.36	.22	19.0	3.1	.24
Av.	19.29	.10	16.10	16.12	3.20	6.1	6.1	1.3	1.07	.72	.25	.50	.27	26.4	5.0	.31
Group 5—																
Max.	20.62	.20	17.38	17.37	3.61	7.0	7.0	1.8	1.28	.92	.31	.73	.36	39.0	6.8	.34
Min.	17.85	.05	14.30	14.40	2.64	5.5	5.4	1.2	.91	.57	.19	.38	.22	20.0	3.8	.22
Av.	18.88	.12	15.57	15.64	3.38	6.2	6.2	1.5	1.08	.77	.24	.56	.30	29.8	5.0	.30
Group 6—																
Max.	20.39	.37	17.53	17.53	3.04	6.6	6.5	1.6	1.01	.82	.29	.62	.34	33.0	8.8	.24
Min.	19.05	.04	16.31	16.36	2.54	6.1	6.2	1.4	.87	.73	.22	.45	.29	23.8	5.6	.18
Av.	19.66	.18	16.86	16.84	2.80	6.3	6.3	1.4	.93	.78	.26	.52	.31	27.7	7.3	.2
General—																
Max.	20.78	.37	17.53	17.53	3.61	7.0	7.0	1.8	1.28	1.01	.36	.79	.37	42.0	8.8	.37
Min.	14.20	.02	11.52	11.41	2.45	4.3	4.4	0.8	.81	.56	.12	.36	.22	19.0	3.1	.07
Av.	18.33	.12	15.31	15.33	3.02	6.0	6.0	1.3	1.01	.74	.23	.54	.29	28.7	5.1	.24

METHODS OF ANALYSIS.

Solids: From the specific gravity and the alcohol content. The specific gravity was obtained from the Brix reading at 17.5° C.

Alcohol: By immersion refractometer.

Nonsugar solids: From solids and sugars before inversion.

Acid: Spotted into litmus solution.

Polarizations: On solutions clarified with normal lead acetate.

Total tartaric acid: Hartmann and Eoff method (U. S. Dept. Agr., Bur. Chem. Bul. 162: 72).

Free tartaric acid and cream of tartar: Calculated from total tartaric acid and the alkalinites of the ash (U. S. Dept. Agr., Bur. Chem. Bul. 162: 75).

Tannin and coloring matter: Loewenthal's method.

ADDITIONAL DETERMINATIONS.

In the course of the investigation a number of determinations not incorporated in the tables of composition were made. These results are given in Table 12.

TABLE 12.—*Additional chemical determinations of constituents of Concord grape juice.*

Group.	P_2O_5.	Cl.	SO_3.	Volatile acid as acetic.	Nitrogen.
	Mg. per 100 cc.	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*	*Grams per 100 cc.*
1	24.2	0.0025	.....	.....	.....
	21.2	.0018	.....	.....	.....
2	16.9	.....	.....	0.01	.....
	15.5	.....	.....	.01	.....
	16.7	.....	.....	.01	.....
	17.7	.....	.....	.01	.....
3	17.5	.0018	0.0080	.....	.....
	19.0	.0018	.0116	.....	.....
	20.6	.....	.....	.01	.....
	20.0	.....	.....	.01	.....
4	15.6	.0014	.0082	.....	.....
	18.0	.0021	.0075	.....	.....
	21.1	.....	.....	.01	.....
	23.6	.....	.....	.01	.....
	22.3	.....	.....	.01	.....
	21.3	.0021	.....	.....	0.051
5	17.6	.0018	.0089	.....	.....
	19.5	.....	.....	.01	.....
	18.6	.....	.....	.01	.....
	21.8	.0025	.....	.....	.054
	19.0	.0025	.....	.....	.054
	20.2	.0021	.....	.....	.043
6	39.7	.....	.....	.02	.....
	35.7	.....	.....	.04	.....
	36.9	.....	.....	.04	.....
	38.1	.....	.....	.03	.....
	39.7	.....	.....	.02	.....
	41.2	.....	.....	.02	.....
	39.4	.....	.....	.03	.....

The volatile esters were also determined on 19 samples from the six different factories, and found to range between 0.12 and 0.23 gram per 100 cubic centimeters, with an average of 0.16 gram per 100 cubic centimeres.

SUMMARY.

Generally speaking, a Concord grape juice properly prepared contains small amounts of alcohol. The juice contains more than 0.4 per cent by volume only when too much time has been allowed for the pressing period. A pure Concord grape juice has not been found to contain sucrose. The polarization of the inverted solution at 87° C. is levorotatory. The free malic acid of a grape juice, figured approximately from the acidity of the juice, free tartaric acid, and the total alkalinities of the ash,[1] amounts on an average to about 0.5 gram per 100 cubic centimeters. The Concord grape juices examined contained free tartaric acid. The cream of tartar of a Concord grape juice amounts to about 0.54 gram per 100 cubic centimeters, ranging between 0.36 and 0.79 grams.

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[1] U. S. Dept. Agr., Bur. Chem. Bul. 162: 75.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 657

Contribution from the Bureau of Chemistry
CARL L. ALSBERG, Chief

Washington, D. C. PROFESSIONAL PAPER. May 2, 1918

A WHEATLESS RATION FOR THE RAPID INCREASE OF FLESH ON YOUNG CHICKENS.

By M. E. Pennington, *Chief*, H. A. McAleer, *Investigator in Poultry and Egg Handling*, and A. D. Greenlee, *Assistant Chemist*, assisted by A. W. Broomell, *Assistant Chemist*, L. E. Harker, *Aid in Poultry and Egg Handling*, and H. L. Shrader, *Investigator in Poultry and Egg Handling, Food Research Laboratory.*

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THE WHEATLESS RATION for the commercial or coop fleshing of young chickens for market discussed in this bulletin offers to commercial feeders a singularly efficient and economical ration for the rapid increase of chicken flesh. This ration, composed of corn meal, dried distillers' grains (corn), and fresh buttermilk, was fed again and again throughout the whole feeding season, and produced in 14 days' coop feeding an average gain of a pound for 7.91 pounds of wet feed consumed, or 4.63 pounds of solids. The employment of distillers' grains makes this ration of especial importance to feeding plants accessible to distilleries engaged in producing commercial alcohol from corn.

The tests reported were made under commercial rather than farm methods of feeding poultry. The aim of the commercial feeder is to increase the flesh of young birds rapidly and economically in a brief period after they are received from the farms. This necessitates the use of feeding coops which allow the chickens little exercise and the regular and abundant feeding of the birds under clean conditions. It calls for special equipment and for use of time and employment of labor to a degree not possible on most farms.

In order that full benefit from the flesh added rapidly by special feeding may be realized, it is necessary to slaughter the chickens immediately and dry pick and chill them without delay. It has been

found that soft meated live chickens in transit lose flesh rapidly and that wet picking, scalding, or chilling birds in water, the methods usual in farm preparation, waste substance and lessen the flavor and the keeping quality of the birds. For these reasons it is rarely profitable for a farmer to coop fatten, or finish chickens at home and ship them alive or as farm dressed poultry for distant markets. As a result, more and more young chickens are being collected at central feeding stations (fig. 1, Pl. I), there to be fleshed quickly for market, and slaughtered, dressed, chilled, and shipped without intervening loss of flesh or flavor. The fleshing stations vary in size from those with a capacity of 30,000 to those holding 1,000 head, depending upon the size of the packing house attached. It is believed that final coop finishing for market under certain conditions will offer returns as a centralized cooperative activity for a group of farmers producing an important aggregate of chickens each season.

COMPOSITION OF RATIONS USED.

It is possible to produce high quality flesh for food purposes very rapidly and at comparatively small expense by feeding chickens a suitable ration under appropriate conditions. Various rations based upon grain mixtures wet with water or buttermilk have been used by commercial feeders. The grains most commonly used are mixtures of corn and wheat. To these are added oats and occasionally barley. One of the rations to be discussed in this bulletin includes distillers' grains, which have not been used to any extent in chicken fleshing. Rations composed of corn meal and buttermilk, and of corn meal and water have been fed simultaneously with the corn meal, distillers' grains, and buttermilk. The comparative efficiency of the three rations is given in the following pages.

Composition of Rations.

	Pounds.
Ration A:	
No. 3 whole corn, ground to a fine meal	100
Water	127
Ration B:	
No. 3 whole corn, ground to a fine meal	100
Fresh buttermilk	150
Ration C:	
No. 3 whole corn, ground to a fine meal	75
Dried distillers' grains (corn)	25
Fresh buttermilk	150

When dried buttermilk is used 10 pounds of the powder should be added to 90 pounds of water. Ration C is thicker in consistency than the ration commonly fed. It should not be thinned, as is the tendency among feeders using it for the first time.

A chemical analysis of these feedstuffs and of the compounded rations showed the compositions indicated in Table 1. These results are the mean analyses of six lots of corn meal and two lots

of distillers' grains used during the fleshing experiments. The buttermilk was examined daily for acid and total solids.

TABLE 1.—*Chemical composition of the feedstuffs and the rations used in the poultry fleshing experiments.*

	Corn meal.	Buttermilk.	Distillers' grains.[1]	Rations.		
				A.	B.	C.[2]
Moisture (per cent)	12.22	91.77	7.98	60.94	59.95	59.53
Total solids (per cent)	87.78	8.23	92.02	39.06	40.05	40.47
Fat (per cent)	3.85	.52	12.30	1.71	1.85	2.70
Total nitrogen (per cent)	1.40	.45	4.24	.62	.84	1.22
Protein (per cent)	8.75	2.96	26.50	3.88	5.28	7.05
Ash (per cent)	1.38	.86	4.57	.60	1.07	1.39
Crude fiber (per cent)	2.16	.....	8.14	.96	.86	1.46
Lactose and lactic acid (per cent)	.....	3.89	.....	.....	2.33	2.33
Nitrogen-free extract (per cent)	.....	.....	.....	31.91	28.66	25.54

[1] Average composition of lots 2 and 3.
[2] Average composition of ration prepared with lots 2 and 3 of distillers' grains.

It will be observed that the total solids in the three rations are approximately the same, the maximum variation being 1.41 per cent. There is 2.70 per cent of fat in Ration C, and the ash and protein contents are also distinctly higher. The amount of protein is especially noteworthy because it is the aim in this work to produce a flesh of desirable food composition, which implies a "fleshing" rather than a "fattening" and a deposition of fat in the edible portions of the bird rather than around the viscera. The higher content of mineral ash is in accord with the results obtained in recent nutrition investigations. Attention should be called to the fact that part of the protein in the distillers' grains is in the yeast cells which remain after the alcohol is removed by distillation. During the course of this work it has also been found that the distillers' grains on the market vary widely in composition, as may be seen from Table 2 which gives the analyses of four lots purchased at different times from the same firm.

TABLE 2.—*Chemical composition of distillers' grains.*

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Average.
Moisture (per cent)	6.51	4.98	10.97	8.65	7.78
Total solids (per cent)	93.49	95.02	89.03	91.35	92.22
Fat (per cent)	10.47	15.97	8.62	8.82	10.97
Total nitrogen (per cent)	5.31	4.40	4.07	4.08	4.47
Protein (per cent)	33.18	27.50	25.44	25.50	27.94
Ash (per cent)	3.42	4.45	4.68	4.12	4.17
Crude fiber (per cent)	10.71	8.14	8.14	8.35	8.84

CHARACTER OF BIRDS FED.

The observations reported were made on young chickens of the class commonly known as "broilers." When received from the farm the weights varied from $\frac{3}{4}$ pound to $2\frac{1}{2}$ pounds, with an average

of $1\frac{7}{10}$ pounds. Very few were pure bred, but practically all had a predominant utility breed strain. Barred Rock blood was the most common. Birds showing markedly low vitality or deformity or sickness were excluded, but a commercial liberality was exercised in selecting stock for the feeding cages. Such a selection is advantageous when feeding large numbers of birds, and should be practiced as a part of routine management. Birds which are not adapted to gain weight ordinarily lose weight, regardless of the care given; hence to feed them is a loss to all concerned. They should be slaughtered as soon as received.

As a general rule the nearer the poultry packing house feeding station is to the farm, the better. A haul, generally by train, is, however, often necessary in the transfer of feeder stock from the farm to the feeding station. Accordingly, all the birds used in these experiments were subjected to a haul requiring from a few hours to more than 24 hours. The birds were selected as promptly as possible after arrival, placed in the feeding cages, and fed corn meal and buttermilk for 24 hours, to eliminate stuffed crops, undue thirst, and restlessness, before beginning to feed the three experimental rations.

The cages were entirely of metal, with compartments for individual birds, and feed cups so constructed that the splashing of the thin feed was impossible. In essentials they were comparable with the feeding batteries in commercial use, one of which is shown in figure 2, Plate I.

TOTAL GAINS IN WEIGHT.

All the birds were fed for 14 days. To determine the rate of gain, the birds were weighed on the first, fourth, eleventh, and fourteenth days. The results in detail are shown in Table 3, in which 13 experiments, comprising from 30 to 42 birds each, are summarized. The experiments were begun in May, and were repeated until October, that the climatic conditions might have their usual effect on the birds. Each group of birds is designated in accordance with the ration received as A, B, or C, respectively.

TABLE 3.—*Summary of changes in weight of 100 head of young chickens.*

	Ration A.	Ration B.	Ration C.
Initial number of chickens	100	100	100
Period of fleshing (days)	14	14	14
Death loss (per cent of initial number)	2.4	0	0
Initial live weight (pounds)	172.1	169.7	171.1
Final live weight (pounds)	180.7	221.3	231.0
Total gain in live weight:			
Difference between final and initial live weights (pounds)	8.6	51.6	59.9
Calculated as per cent of initial live weight	5.00	30.41	35.01
Dressed weight (pounds)	162.7	199.0	207.3
Chilled weight (pounds)	161.8	197.7	205.8
Average initial live weight (pounds)	1.7	1.7	1.7
Average final live weight (pounds)	[1] 1.9	2.2	2.3
Average dressed weight (pounds)	[1] 1.7	2.0	2.1
Average chilled weight (pounds)	[1] 1.7	2.0	2.1

[1] Average weight of the surviving chickens.

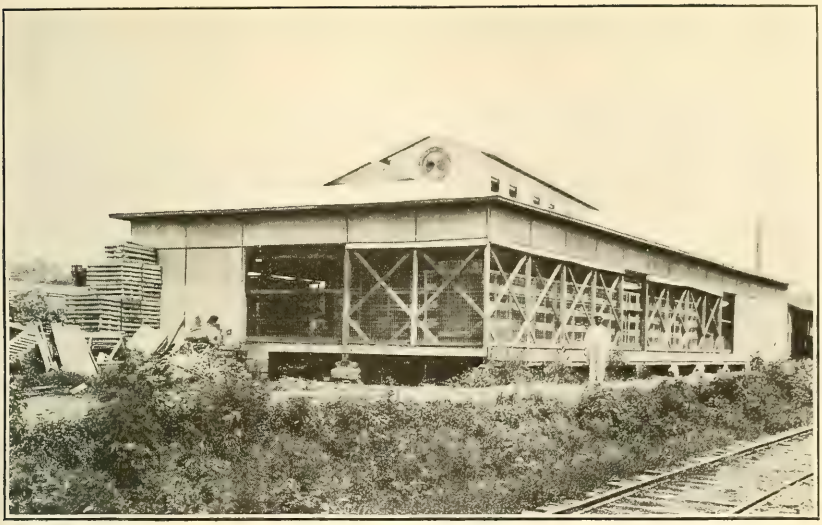

FIG. 1.—TYPICAL SMALL FEEDING STATION.

FIG. 2.—FEEDING BATTERIES.

The total initial weight of all the birds when feeding began is comparable with the "initial live weight" of the commercial feeder, and the total live weight of all the birds when ready for slaughter is comparable with the "final live weight" of the commercial feeder. The difference, in pounds, between the "in" and "out" weights is given in Table 3. For example, the "in" weight of 100 birds on Ration C was 171 pounds and the "out" weight 231 pounds, or a gain of 60 pounds to the 100 head. For broader usefulness the results have been expressed also as percentage of gain, taking the initial live weight as the basis of comparison. Ration A, corn meal and water, gave a total gain of only 5 per cent; Ration B, corn meal and buttermilk, gave a gain of approximately 30 per cent; while Ration C, corn meal, distillers' grains, and buttermilk, gave a gain of about 35 per cent.

QUANTITY OF FEED REQUIRED.

It is essential that the ration used for fleshing chickens be palatable to them. Birds will starve rather than eat a distasteful feed. The experiments have shown that Ration C is eaten eagerly and the birds do not tire of it. The appetite at the end of the experiment was even better than at the beginning, quite the reverse of the usual condition. The birds ate more, by weight, of Ration C than of either Ration A or B, as is seen in Table 4. At the end of 14 days 378 pounds of Ration A, 458 of Ration B, and 474 of Ration C had been consumed.

TABLE 4.—*Feed consumed by 100 head of young chickens.*

Feeding period.	Feed.	Ration A.	Ration B.	Ration C.
Days.		*Pounds.*	*Pounds.*	*Pounds.*
4	Grain	47.8	48.8	49.1
	Buttermilk (10 per cent solids)	.....	73.2	73.6
	Water	59.7	.....	.....
	Total feed	107.5	122.0	122.7
8	Grain	97.7	102.1	103.4
	Buttermilk (10 per cent solids)	.....	153.2	155.2
	Water	121.8	.....	.....
	Total feed	219.5	255.3	258.6
11	Grain	133.9	143.3	146.9
	Buttermilk (10 per cent solids)	.....	214.9	220.3
	Water	167.1	.....	.....
	Total feed	301.0	358.2	367.2
14	Grain	168.1	183.2	189.4
	Buttermilk (10 per cent solids)	.....	274.7	284.2
	Water	209.6	.....	.....
	Total feed	377.7	457.9	473.6

Under any circumstances the amount of feed eaten is very much greater than the amount of flesh produced, because a large part of the food of an animal must be used to keep it warm and maintain the body functions. The excess eaten may or may not be deposited

as flesh, depending upon the character of the ration and the animal. It is the aim, when feeding to produce flesh, to deposit in that form as much as possible of the ration fed.

TABLE 5.—*Pounds of feed per pound of gain in live weight.*

Feeding period.	Feed.	Ration A.	Ration B.	Ration C.
Days.		*Pounds.*	*Pounds.*	*Pounds.*
4	Grain	16.08	3.28	3.08
	Buttermilk (10 per cent solids)	.....	4.93	4.61
	Water	20.06	.....	.....
	Total feed	36.14	8.21	7.69
8	Grain	27.56	3.34	3.16
	Buttermilk (10 per cent solids)	.....	5.01	4.74
	Water	34.37	.....	.....
	Total feed	61.93	8.35	7.90
11	Grain	17.64	3.40	3.10
	Buttermilk (10 per cent solids)	.....	5.09	4.66
	Water	22.00	.....	.....
	Total feed	39.64	8.49	7.76
14	Grain	19.54	3.55	3.16
	Buttermilk (10 per cent solids)	.....	5.33	4.75
	Water	24.37	.....	.....
	Total feed	43.91	8.88	7.91

Table 5 shows that of Ration A 43.91 pounds were required to produce a gain in weight of 1 pound. Of Ration B, 8.88 pounds were required, and of Ration C, 7.91 pounds. Expressed differently, it may be said that only 2.28 per cent of the wet feed of Ration A was retained in the form of chicken flesh, while 11.26 per cent of Ration B was so retained, and 12.64 per cent of Ration C (Table 6).

TABLE 6.—*Percentage of wet feed retained as gain in live weight.*

Feeding period.	Ration A.	Ration B.	Ration C.
Days.	*Per cent.*	*Per cent.*	*Per cent.*
4	2.77	12.18	13.00
8	1.61	11.97	12.66
11	2.52	11.77	12.88
14	2.28	11.26	12.64

RATE OF GAIN.

Practical experience has led many of the commercial chicken feeders of the United States to feed young birds for a 14-day period. Sometimes a shorter period is substituted, some feeders claiming that the rate of gain decreases steadily in the second week. An analysis of the data obtained during these experiments shows that in Ration B there is a decrease in the amount of flesh deposited as compared with feed consumed, 8.21 pounds of feed per pound of gain being required during the first four days and 8.88 pounds during the last four days of the 14-day period (Table 5). This does not hold, however, for Ration C, which gives an evenly continuous utilization of feed

throughout the entire 14 days and a deposition of flesh which is practically uniform. It is probable, also, from additional observations which are not sufficiently numerous to tabulate, that gains in weight and good appetites are maintained with Ration C for a period much longer than 14 days. Whether a longer period than 14 days is profitable remains to be determined. The results at hand, however, indicate that young birds should be fed at least 14 days if profitable results are to be obtained.

LOSS IN WEIGHT DUE TO KILLING AND CHILLING.

The practical feeder is frequently called upon to decide whether his fleshing gains are sufficient to be profitable. To do this he must know not only the live weights before and after feeding, but the final weight after dressing and chilling, since it is on the basis of the latter that his sales are made. The losses due to the removal of blood and feathers and the loss by evaporation during cold air chilling are shown in Tables 7 and 8.

The birds designated "before fleshing" in Table 7 were selected at the same time and from the same stock as the birds to be fed. They were killed at once and the carcasses studied as described on page 8. The shrinkage due to dressing was also determined.

TABLE 7.—*Loss in weight on killing and chilling young chickens, before and after fleshing.*

	Ration.	Blood.	Feathers.	Loss on chilling.	Total shrinkage in killing, dressing, and chilling.
		Per cent of final live weight.			
Before fleshing	.....	4.1	5.7	0.7	10.50
After fleshing	A	3.5	6.4	.6	10.46
	B	3.9	6.2	.6	10.67
	C	3.9	6.3	.7	10.92

It will be seen from Table 7 that feeding stimulates feather growth, a fact well known to the practical man. It is difficult to determine exactly the amount of blood which the chicken loses, but the figures presented may be taken as fair. While there is but little difference between the slaughter losses of fleshed and ranger chickens, the former probably lose a little more weight. Of the birds considered in these experiments, those fed Ration C lost a little more weight than their companions on Ration A or B.

Such being the case, a further analysis becomes necessary to determine the relation of this loss to the ultimate weight of chicken ready for the consumer. These figures, which are presented in Table 8, indicate that the 0.25 per cent increase in dressing loss is more than compensated for by the 3.77 per cent greater gain in total weight remaining when Ration C is used. Table 8 shows also the

actual increase in weight remaining to the packer after dressing and on which he must calculate the cost of feeding. For the Rations A, B, and C this is −5.98, +16.50, and +20.27 per cent, respectively, of the initial live weight. The size of the bird must also be considered when calculating the slaughter loss. The foregoing figures are based on birds which showed a dressed weight between 2 and 3 pounds. Birds weighing over 3 pounds, dressed weight, have an increased slaughter loss of from 1 to 2 per cent.

TABLE 8.—*Relation between gain in live weight and total shrinkage (young chickens).*[1]

	Ration A.	Ration B.	Ration C.
Initial live weight (pounds)	100.00	100.00	100.00
Weight gained by fleshing (pounds)	5.00	30.41	35.01
Final live weight (pounds)	105.00	130.41	135.01
Total shrinkage (per cent of final live weight)	10.46	10.67	10.92
Weight lost in total shrinkage (pounds)	10.98	13.91	14.74
Weight gained by fleshing, less total shrinkage (pounds)	−5.98	16.50	20.27

[1] These calculations are based on the average gain in live weight (Table 3) and the average total shrinkage (Table 7) obtained with each ration.

RELATION OF INITIAL WEIGHT TO FINAL GAIN.

The birds used in these experiments averaged 1.7 pounds when they entered the feeding cages. The birds after fleshing weighed on an average 2.2 pounds for Ration B and 2.3 pounds for Ration C. Included in these averages, however, are initial live weights varying from 0.875 pound to 2.5 pounds, and final live weights varying from 1.2 pounds to 3 pounds. The best results were obtained with birds having an initial live weight of 2 pounds or less. Birds over 2 pounds made profitable gains, but showed an irregularity which was less apparent in the younger stock.

TABLE 9.—*Résumé of the change in weight by individual broilers during fleshing for 14 days.*

	Ration A.	Ration B.	Ration C.
Percentage of broilers with gain of—			
Less than 10 per cent of initial live weight	34.68	4.03	0.81
10 per cent or more of initial live weight	44.36	91.93	95.94
20 per cent or more of initial live weight	7.26	79.03	87.00
30 per cent or more of initial live weight	.81	58.06	65.86
40 per cent or more of initial live weight	.....	29.03	39.84
50 per cent or more of initial live weight	.....	9.68	22.77
60 per cent or more of initial live weight	.....	2.42	7.32
70 per cent or more of initial live weight	.....	.....	2.44
Percentage of broilers with loss of—			
Less than 10 per cent of initial live weight	15.32	2.42	1.63
10 per cent or more of initial live weight	5.65	1.61	1.63
20 per cent or more of initial live weight	4.04	.....	.....
30 per cent or more of initial live weight	3.23	.....	.....
40 per cent or more of initial live weight	3.23	.....	.....
100 per cent of initial live weight (died)	2.42	.....	.....
Total number of broilers	124	124	123
Percentage gaining	79.03	95.97	96.75
Percentage losing	20.97	4.03	3.25

Table 9 summarizes the variation in the gain of individual birds on Rations A, B, and C. This summary brings out in striking fashion the relative value of Ration C, and also shows the need of a careful study of individual birds to determine those types which lend themselves to fleshing. For example, the type of bird which on Ration C gained over 60 per cent of its own weight would be vastly more profitable to feed than the type which is limited to 10 or 20 per cent gains. It is encouraging to note, however, that 96.75 per cent of the birds on Ration C gained weight, and 95.97 per cent on Ration B, while only 79.03 per cent on Ration A showed gains.

COMPOSITION OF BROILING CHICKENS BEFORE AND AFTER FLESHING.

If the rapid increase of flesh on chickens is to be of maximum benefit it must include a gain to the consumer in both quality and quantity of foodstuff, as well as additional profit to the feeder and packer. It is very desirable, also, that some definite knowledge be obtained concerning the relation between diet and flesh composition, that animal flesh, like fruits and vegetables, may have a composition adjusted to the market requirements to which it is to be subjected. The relation between the amount of edible and inedible material in the carcass is also a matter of economic moment.

TABLE 10.—*Gross composition of young chickens, before and after fleshing.*

	Ration.	Total edible portion and crude gizzard fat.						Bones.	Offal.	Number of birds dissected.[1]
		Total edible portion.				Gizzard fat (crude).	Total.			
		Meat.	Skin.	Edible viscera.	Total.					
		Per cent of chilled weight.								
Before fleshing		39.0	7.4	7.3	53.7	1.5	55.2	17.7	27.1	78
After fleshing	A	38.6	8.4	6.8	53.8	3.8	57.6	17.2	25.3	41
	B	39.6	9.0	6.6	55.2	3.9	59.1	16.4	24.6	41
	C	40.3	8.2	6.6	55.1	3.2	58.3	16.4	25.3	41

[1] The chickens were dissected in groups, each of which included from 3 to 6 birds.

Table 10 compares the gross composition of ranger chickens, just as they come from the average farm, with similar chickens fed in the feeding station for 14 days on Rations A, B, and C, respectively. A study of the data recorded indicates that apparently a number of changes in gross composition are due to feeding. For example, the amount of meat has been increased from an average of 39.0 to 40.3 per cent, while the total edible portion has been raised from 53.7 to 55.1 per cent. The proportion of bone has been changed from 17.7 to 16.4 per cent, and the offal from 27.1 to 24.6 per cent in Ration B and 25.3 per cent in Ration C. It is also of interest to ob-

serve that of the three rations C tends to lower the amount of fat deposited in the body cavity, although it is higher than in the ranger birds.

TABLE 11.—*Chemical analysis of edible portion of young chickens, before and after fleshing.*

	Ration.	Total edible portion excluding crude gizzard fat.			Crude gizzard fat.	
		Water.	Fat.	Protein.	Water.	Fat.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Before fleshing		70.93	8.51	19.51	25.48	68.93
After fleshing	A	65.88	14.68	18.29	15.33	82.18
	B	65.43	15.73	18.17	16.43	81.08
	C	67.34	13.57	18.26	19.26	78.27

The rapidly formed flesh is relatively richer in fat than the flesh produced under more normal conditions. The protein content is slightly lowered as compared with the ranger. It is quite possible that this change in protein content is due as much to the lack of exercise as to the diet, an assumption borne out by the fact that the protein content is practically the same on all three rations. The water content of the quickly produced flesh is lower than that built up under the normal environment. Apparently the fat which has been forced into the tissue has partly replaced the water of the ranger bird. If we assume that the flesh of the chicken which exercises and lives on the mixed diet of a farm bird has a normal composition, Ration C, fed in captivity, results in a less abnormal flesh than either Ration A or Ration B.

From the viewpoint of eating quality, both Ration B and Ration C are highly desirable. The flesh of the birds fed Ration C is more tender and the flavor is excellent. The removal of the feathers was more difficult than in the case of the birds fed on Rations A and B. This is invariably the case with soft meated as compared with ranger birds and increases with the tenderness of the skin and flesh.

ECONOMIC ADVANTAGE OF FLESHING BROILERS AT THE PACKING HOUSE.

These results show that young chickens can be made to gain more than one-third of their initial weight as ranging birds by confining them in suitable quarters and feeding to them a suitable ration for a period of two weeks. Considered on the basis of the individual small broiler, or even on the basis of the young cockerels of the farm flock, the resultant number of pounds of additional foodstuff is not great. Considered, however, on the basis of the usual carload—which is the commercial unit of dressed poultry—the figures assume a new significance. Table 12 gives a résumé of the gains in weight, the dressing losses, and the increase in foodstuff to the consumer on the 20,000-pound carload of dressed poultry.

TABLE 12.—*Gain in live and chilled weights, total edible portion, protein, and fat produced by fleshing 1 carload (chilled weight, 20,000 pounds) of farm (unfleshed) broilers for 14 days.*

	Farm.	Ration A.	Ration B.	Ration C.
Initial live weight (pounds)	22,346.4	22,346.4	22,346.4	22,346.4
Gain in live weight by fleshing (per cent of initial live weight)	0	5.00	30.36	34.97
Final live weight (pounds)	22,346.4	23,463.7	29,130.8	30,160.9
Gain in live weight (pounds)	.....	1,117.3	6,784.4	7,814.5
Total shrinkage (killing, dressing, chilling) (per cent of final live weight)	10.50	10.46	10.67	10.92
Chilled weight (pounds)	20,000.0	21,009.4	26,022.5	26,867.3
Total edible portion (meat, skin, edible viscera) (per cent of chilled weight)	53.7	53.8	55.2	55.1
Weight of total edible portion (pounds)	10,740.0	11,303.1	14,364.4	14,803.9
Protein (per cent of total edible portion)	19.51	18.29	18.17	18.26
Fat (per cent of total edible portion)	8.51	14.68	15.73	13.57
Weight of protein in total edible portion (pounds)	2,095.4	2,067.3	2,610.0	2,703.2
Weight of fat in total edible portion (pounds)	914.0	1,659.3	2,259.5	2,008.9
Crude gizzard fat (per cent of chilled weight)	1.5	3.8	3.9	3.2
Weight of crude gizzard fat (pounds)	300.0	798.4	1,014.9	859.8
Fat in crude gizzard fat (per cent)	68.93	82.18	81.08	78.27
Fat in crude gizzard fat (pounds)	206.8	656.1	822.9	673.0
Gain on 1 carload by fleshing:				
Chilled weight (pounds)	.....	1,009.4	6,022.5	6,867.3
Total edible portion (pounds)	.....	563.1	3,624.4	4,063.9
Protein of total edible portion (pounds)	.....	−28.1	+514.6	+607.8
Fat of total edible portion (pounds)	.....	745.3	1,345.5	1,094.9
Fat of crude gizzard fat (pounds)	.....	449.3	616.1	466.2
Total fat (in total edible portion and crude gizzard fat) (pounds)	.....	1,194.6	1,961.6	1,561.1
Total gained fat deposited in total edible portion (per cent)	.....	62.39	68.59	70.14
Crude gizzard fat gained (pounds)	.....	498.4	714.9	559.8

Table 12 shows that the gain in weight on one carload by fleshing with Ration C amounts to about 6,867 pounds, or 845 pounds more than was gained by Ration B. It is this gain in weight which makes the properly managed feeding station profitable to the poultry packer. The gain in edible meat of high quality amounts in round numbers to 4,064 pounds with Ration C, and to 3,624 pounds with Ration B, an important consideration to the consumer. This total gain to the consumer is divided, in Ration C chickens, into 608 pounds of protein and 1,561 pounds of fat, 1,095 pounds of the fat being deposited in the muscle tissue and skin. It is also noteworthy that with Ration C, 70.14 per cent of the fat gained by fleshing is deposited in the edible portion of the bird rather than in the body cavity, a gain of nearly 2 per cent, as compared with Ration B.

SUMMARY.

Rations composed of corn meal and water (A), corn meal and buttermilk (B), and corn meal, distillers' grains and buttermilk (C) have been fed to young chickens of less than 3 pounds in weight as they came from the farm with the following results:

(1) Ration A, after a two weeks' feeding period, gave a gain of 5 per cent of the initial weight.

Ration B, after a two weeks' feeding period, gave a gain of 30.41 per cent of the initial weight.

Ration C, after a two weeks' feeding period, gave a gain of 35.01 per cent of the initial weight.

(2) The amount of wet feed required to produce a gain of 1 pound of flesh in 14 days was as follows:

Ration A, 43.91 pounds (grain, 19.54 pounds).
Ration B, 8.88 pounds (grain, 3.55 pounds).
Ration C, 7.91 pounds (grain, 3.16 pounds).

(3) The rate of gain with ration A was irregular. The rate of gain with Ration B decreased slightly toward the end of the feeding period. The gain with Ration C was practically uniform.

(4) The amount of feed required to produce 1 pound of flesh during 4, 8, 11, and 14 days, respectively, varied widely with Ration A. With Ration B there was a slight progressive increase in the amount of food required per pound of gain as the feeding progressed, while with Ration C the amount required for each period was practically constant.

(5) The loss of weight due to the removal of blood and feathers and the evaporation of moisture from the flesh while chilling 24 hours in air at 32° F. amounts to nearly 11 per cent of the live weight. The birds from the farm and the birds on Ration A lost about the same weight, while birds on Rations B and C lost a little more. The actual result in weight to the packer as compared with the farm weight was for Ration A, −5.98 per cent, for Ration B, +16.50, and for Ration C, +20.27 per cent.

(6) The highest and cheapest gains were made by birds having an initial weight of 2 pounds or less.

(7) By feeding Rations B or C the total edible portion of the birds is increased from 53.7 to 55.2 per cent. Rations A and B tend to deposit more fat in the body cavity than does Ration C.

(8) If every 20,000-pound carload of broilers slaughtered as they come from the farm should be fed for 2 weeks on Ration C, the gain in weight to the packer would average 6,867 pounds. The gain in edible meat would amount to 4,064 pounds, of which approximately 608 pounds are protein and 1,561 pounds are fat.

(9) Chicken flesh increased at the rate and under the conditions indicated differs from that produced by the bird when unconfined, chemically, physiologically, and in its eating quality. It is for food purposes only; hence the deductions drawn on the basis of the experiments reported must not be applied to birds intended for egg production or for breeding stock, or to the feeding of birds ranging on the farm.

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FOREST DISEASE SURVEYS.

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INTRODUCTION.

The National Forests are administered with the expectation of their becoming self-supporting through the medium of returns from such activities as timber sales, grazing, and special-use privileges. Of these operations, that of the sale of timber is, in the National Forests of the northwestern United States, unquestionably of the greatest importance in respect to paying the expense of administering the forest. In district No. 1 in the year 1916 the total receipts from timber sales equaled $439,880 and grazing $50,836. These figures show the relation between the two incomes derived from the principal forest activities of this district. Some few of the forests have already attained a position of self-support. One forest in particular is reported to have outdone all expectations and in so doing has aided in the administration of forests whose incomes have been less than their expenses. In such self-supporting forests it is always found that a ready market and available timber supply have resulted in a maximum of timber sales. It is, then, a foregone conclusion that timber sales in the National Forests of the Northwest are the mainstay of a self-supporting policy and that all data of value to timber-sale operations are bound to be of value in their successful supervision. The data and recommendations included in this paper are based on conditions prevalent in district No. 1 of the United States Forest Service.

OBJECT OF FOREST DISEASE SURVEYS.

Timber surveys have as their prime object the gathering of such data upon proposed sales areas as will be of use in the appraisal and administration of the sales, and it is this survey which makes the sale possible. The collection of valuable data on the board-feet con-

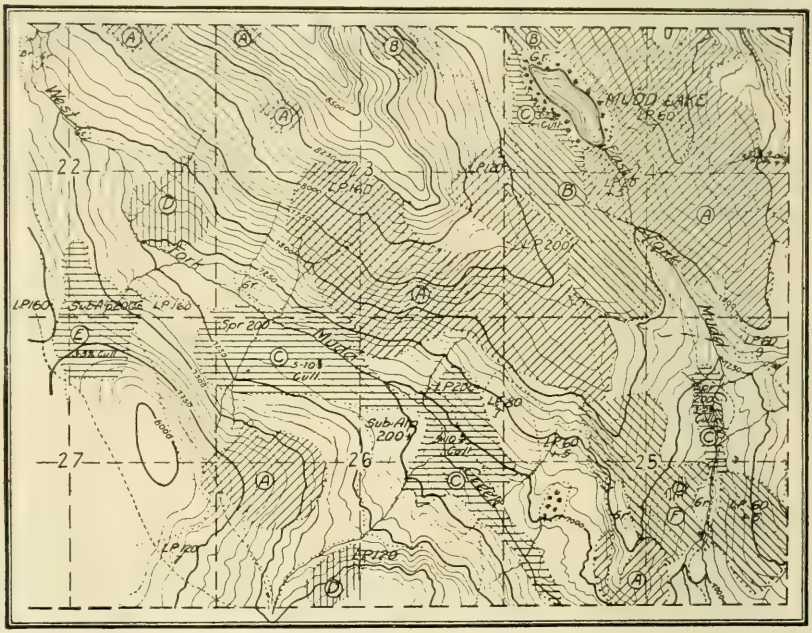

FIG. 1.—Pathological map of sections 22, 23, 24, 25, 26, and 27, T. 2 N., R. 15 W., the Big Hole area, based upon the map of the timber survey of that area in the Deerlodge National Forest, Mont., showing timbered areas infected with disease. The rot percentages are indicated for heart-rot (*Trametes pini* (Brot.) Fr.) and butt-rot (*Polyporus schweinitzii* Fr.) only. Crosshatching indicates infection areas. Other symbols on the map are part of the Forest Service map legend, such as Spr. 200, which indicates Engelmann spruce, 200-year age class; L. P. 60, 0.7 equals lodgepole pine 60-year age class, density 0.7; Gr. equals grassland; Br. equals brush. *A*, Pine rust (*Cronartium coleosporioides* (D. and H.) Arthur), gall and blister forms, on lodgepole pine (*Pinus contorta*); *B*, smelter-smoke injury, principally of alpine fir (*Abies lasiocarpa*) and Douglas fir (*Pseudotsuga taxifolia*); *C*, honeycomb rot (*Trametes pini* (Brot.) Fr.), principally on Engelmann spruce (*Picea engelmanni*); *D*, porcupine injury—peeling of bark and girdling of lodgepole pine; *E*, cubical butt-rot (*Polyporus schweinitzii* Fr.) on lodgepole pine and white-bark pine (*Pinus albicaulis*); *F*, mistletoe (*Razoumofskya americana* (Nutt.) Kuntze) on lodgepole pine.

tents of the stand, cull percentages, forest types, age classes, topography, and logging factors is followed by an accurate map portraying the topography, types, density, age classes, and timber estimates. A careful stumpage appraisal of the area based upon these available data and upon the various economic and topographic factors forms the final step before contracts are let.

In most cases the appraisal of a timber-sale area is based somewhat low in respect to the total feet board measure of sound material, principally on account of the unknown amount of defect or rot to be encountered and sometimes partially for other causes, foremost of which is the desire to prevent overestimation.

In timber surveys the estimating of timber is performed by members of the party who have been trained to estimate stands of varying mixtures, age, and soundness and who are thoroughly capable of

FIG. 2.—Fruiting bodies of *Trametes pini* on lodgepole pine. Notice the swelling of the trunk where the fruiting bodies are attached. (Photographed by G. G. Hedgcock.)

judging the board-feet contents of trees within reasonable limits of error. The addition to the party of an expert cruiser has been made as a means of aiding the estimators in this work and checking their results. The determination of the correct cull percentage due to rot is the aim of this arrangement in the crew.

In certain types and ages of stand the estimate may come close to the true scale, but, again, too small a percentage is deducted for cull due to rot, and consequently the estimate runs too high. A sale contractor figuring possibly on a conservative margin and accepting the

estimate at its face value may find upon cutting the stand that a great deal more rot is encountered than was expected. This fact alone could easily result in the logging operation turning out a loss instead of a profit, especially if the logging chance is not a favorable one. Such failures doubtless do not encourage the undertaking of further contracts, and fewer timber sales are the result. This has its ultimate effect upon the forest as a whole in an economic way.

Recent studies made of the rots occurring[1] in forest trees have given information concerning the amount of decay prevalent in different age classes and in different sites for a particular species of tree. These studies have indicated that the decay in a tree or a stand varies with such factors as age of stand, site, density, injuries, and moisture relations. Such being the case, a disease survey of the sales areas made either as a separate pathological survey or in conjunc-

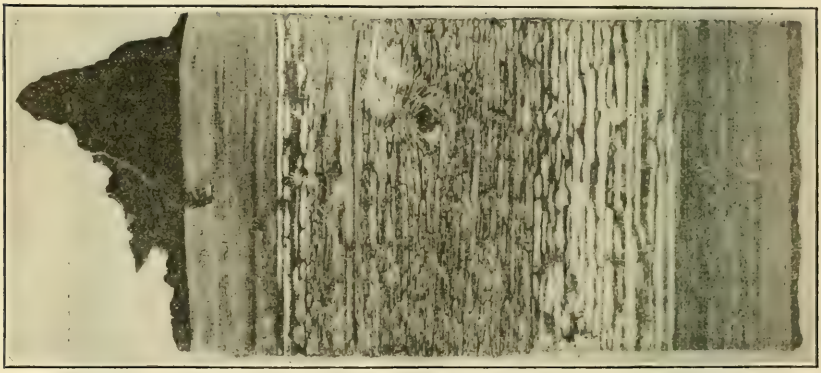

FIG. 3.—Typical rot of *Trametes pini* (honeycomb rot) in white pine.

tion with the usual timber surveys would prove of immense value in a closer estimate of the sound board-feet contents of the stands. A disease survey in conjunction with the timber-survey work would no doubt be the more feasible plan of the two, since it would require no additional men for the crews and should not appreciably affect the cost per acre. All that would be required in order to secure the disease data in more accurate form is the training of one of the members of each unit crew in the proper methods by which the various pathological determinations are made. This would mean the ability to judge more accurately the cull percentage due to rot and the ability to recognize all the outward indications of decay as well as the principal fungi attacking forest trees. Preferably, the estimator should be the one selected to assume this duty, as it is his individual work which determines the total estimate and the cull percentage of the stand.

[1] Meinecke, E. P. Forest pathology in forest regulation. U. S. Dept. Agr. Bul. 275, 62 p. 1916.

The topographer, while sketching in the type lines and indicating the age class divisions, can at the same time indicate the boundaries

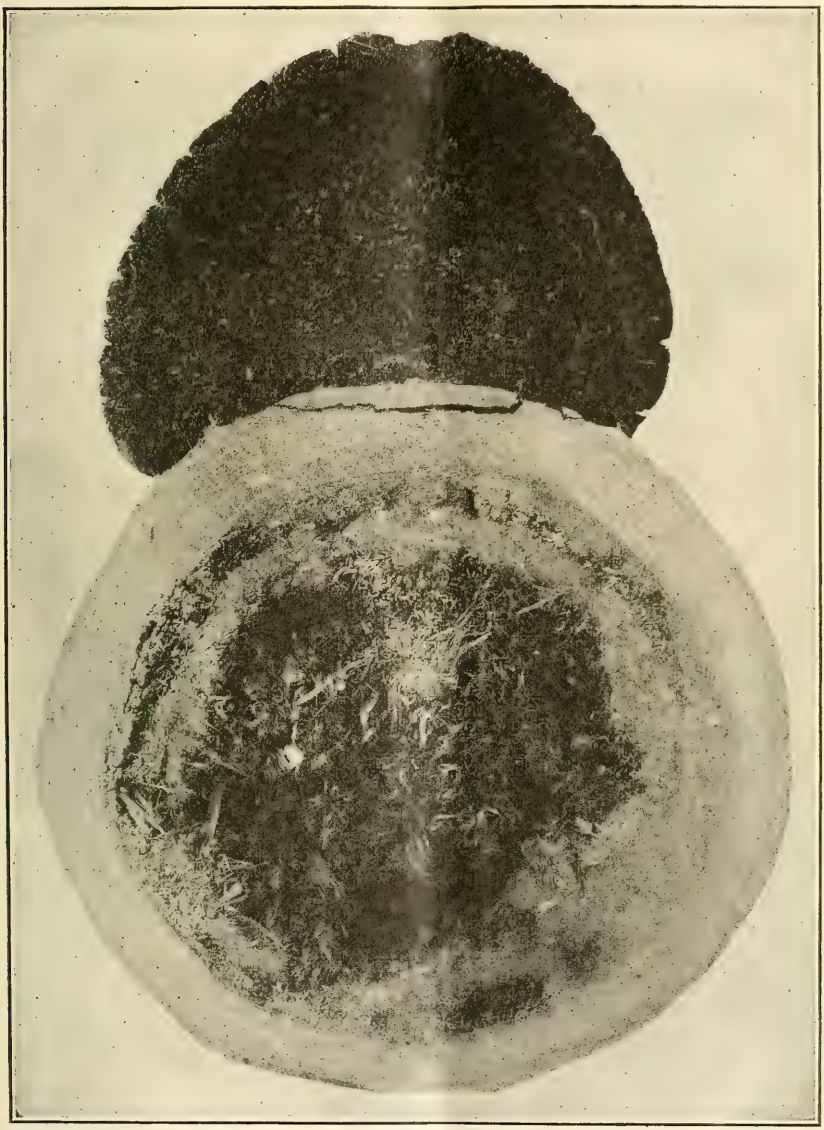

FIG. 4.—Typical rot of the Indian-paint fungus on *Abies grandis*. Note the spines on the fruiting body of the fungus. (Photographed by G. G. Hedgcock.)

of the heavier disease infections and also pencil in the cull percentages. In this way a pathological map[1] can be secured for the area

[1] Weir, J. R. Some suggestions on the control of mistletoe in the National Forests of the Northwest. *In* Forestry Quart., v. 14, no. 4, p. 567–577. 1916.

surveyed, and along with careful notes of the estimator upon the diseased areas and upon data secured by means of a few small sample

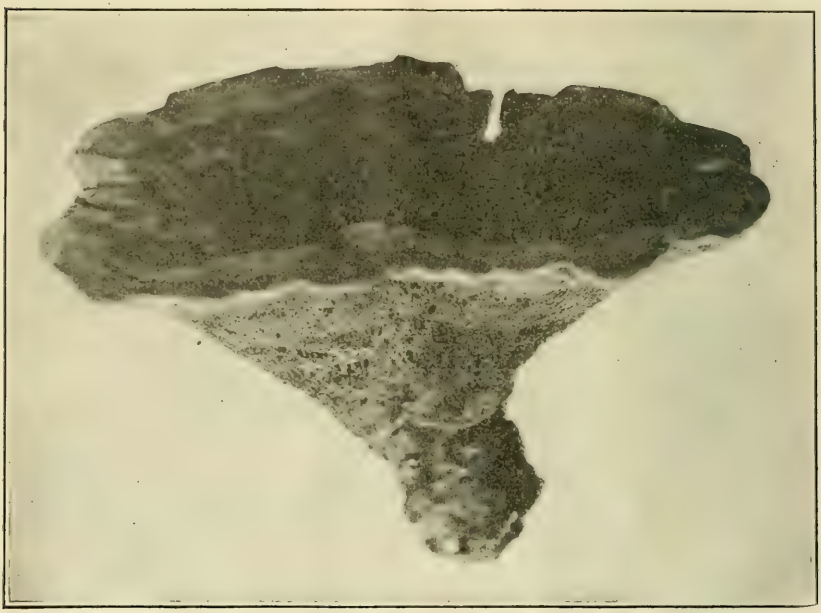

FIG. 5.—*Polyporus schweinitzii*, the velvet-top fungus.

FIG. 6.—Typical rot of the velvet-top fungus in the end of a white-pine log. Note the cubical character of the rot.

plats a very close estimate of the cull percentage to be expected can be had. Checks can be made upon the estimator's work by the expert cruiser. Members of the Office of Investigations in Forest Pathology can render excellent service by aiding each unit crew in the field in becoming familiar with the various diseases and their causes.

If properly adjusted, this work would cause no variations in the amount of line run per day by the unit crews. The junior

writer has tested and proved this assertion in practice while employed by the Forest Service on the Big Hole timber survey made in 1914 in the Deerlodge National Forest of Montana. From the data thus collected pathological maps were made, giving in colors the areas of the stand infected, respectively, with the pine rust (*Cronartium coleosporioides* (D. and H.) Arthur), both gall and blister forms, mistletoe (*Razoumofskya americana* (Nutt.) Kuntze), heart-rots (*Trametes pini* (Brot.) Fr. and *Polyporus schweinitzii* Fr.), and various other diseases (fig. 1). Careful notes

FIG. 7.—*Fomes pinicola,* the red-belt Fomes growing on grand fir.

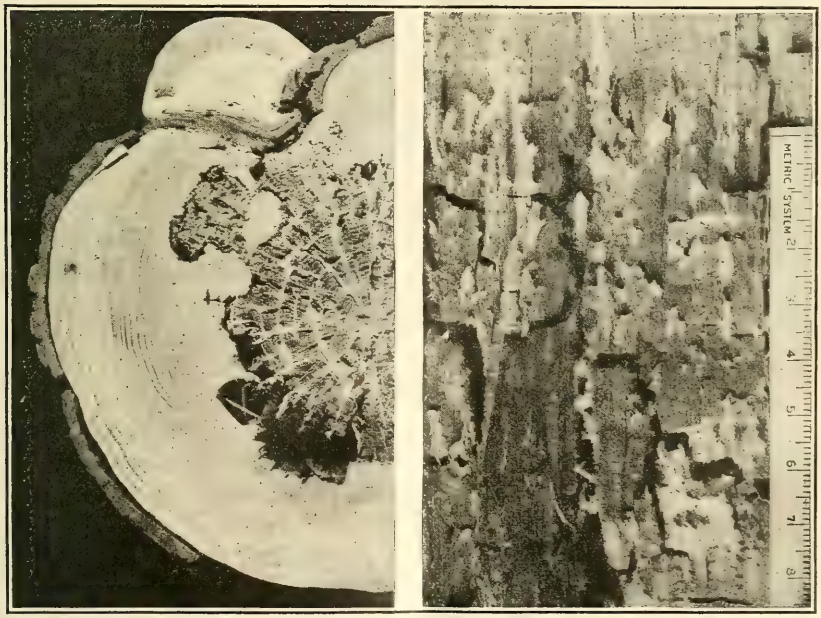

FIG. 8.—Typical rot of the red-belt Fomes in grand fir; cross and tangential sections. Note the strands of white felty masses (mycelium) throughout the rotted areas.

were taken as to the percentage of infection in each case, and a closer estimate of the amount of cull was made possible. In one particular

case an estimator wished to give a full estimate of a stand of white-bark pine (*Pinus albicaulis* Engelm.) growing upon a flat ridge. The trees of this stand upon closer examination were found to be almost universally heart-rotted with *Polyporus schweinitzii* for a distance of 5 to 12 feet up from the base. The trees were fairly large and if sound would have made excellent stull material, the chief product in the Big Hole Basin region of Montana. Giving a full estimate to these trees would have meant a serious overestimation of the stand, since it was finally estimated that about 40 to 50 per cent by volume was cull due to the heart-rot. Fruiting bodies of the causal fungus almost hidden in the débris at the base of the trees gave the determining clue, and soundings upon the trunk followed by notching completed the determination.

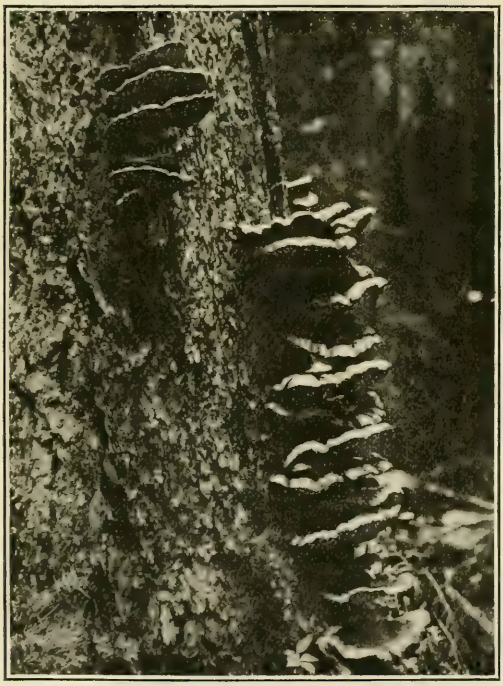

FIG. 9.—*Polyporus sulphurcus*, sulphur fungus, at base of larch.

There has always been a serious need for some method by which a fairly accurate estimate can be made of the rate of decay of a stand of timber.

Good results as to the probable cull percentage to be expected from rot upon a certain stand have been secured by expert and experienced cruisers and appraisers. Timber surveys have in most cases placed the estimates of sound timber within a reasonable limit of error; but evidently no attempt has ever been made to secure a more accurate result in respect to the cull in a stand due to rot other than those results secured by ocular estimates. Occasionally in the administration of National Forests the question arises concerning the probable rate of increase in rot per annum in a certain stand of timber. The resultant decision as to the time of disposal of the timber hanging in the balance depends upon the amount of accurate knowledge and the data at hand regarding the decay in the trees. If proper and sufficient data are secured, these will furnish the total volume and the total volume of rot for the stand in question. With these as a

basis and figuring in all the economic and silvicultural factors concerned, a cutting age can be computed, aimed to secure the greatest amount of sound material at a minimum of cost. No definite rule can be given as to the value of the ratio between the total volume and the volume of rot required in determining the cutting age. Too many factors are concerned even to generalize, and each stand must be judged according to the conditions present at the time it is under consideration. But it is unquestionably true that data giving the relation between the sound and the decay increment in a stand, as well as giving an approximation of the rate of increase in decay to be expected, will aid greatly in solving the question of the proper cutting age for that stand.

FIG. 10.—Typical rot of the sulphur fungus in larch.

Forest management of this kind can be practiced to a profitable end provided intensive methods are employed in making a special disease survey of the area in question. Surely this would be a step toward more intensive and more economic forest management and would aid in solving many of the perplexing problems hinging upon the decay in timber. The cost of such a survey would not be prohibitive by any means, even in case the stand were composed of more than one age class, since sample plats of small dimensions could be successfully used in securing the necessary data upon the decay. To supplement these and aid in the diagnosis of the stand, such available data previously secured for similar tree species, age classes, sites, etc., could be used to advantage.

Aside from the advantage secured in arriving at a more accurate rot percentage for a stand, a disease survey accompanied by a pathological map would be extremely useful after the sales are closed, the brush burned, and preparations made for the reforestation of the cut-over area. Looking into the future is the forester's basic prin-

ciple, and whenever forestation of an area either by natural or artificial reproduction is contemplated it would be extremely unwise to overlook the risks to the young growth incurred by possible disease. A pathological map would serve to give the previous location of diseased trees, as well as the location of diseased uncut areas surrounding the sale area and the localities and sites where diseases seem most prevalent, and would also serve to indicate whether the seed trees left, if any, were of a group which was heavily diseased or not. Diseased trees of any kind left as seed trees or otherwise on or surrounding a cut-over area always act as distributing points of disease to the young growth occupying the near-by areas. For this reason attention has recently been centered upon the introduction and strict enforcement of sanitation clauses in all timber-sale operations.[1] These clauses include the removal by burning of all heavily infected standing trees and all cull material left on the area and strongly advise the use of healthy trees as seed trees instead of diseased ones.

FIG. 11.—*Fomes officinalis*, chalk fungus, on western larch.

For the same reason as given above for the protection of young growth in cut-over areas, a disease survey is even more necessary upon proposed nursery sites, present nursery sites, and all plantation sites. Wherever young trees are grown in close proximity to heavily diseased native trees or alternate hosts of forest-tree rusts there

[1] Meinecke, E. P. Forest-tree diseases common in California and Nevada. U. S. Forest Service Manual, p. 62. Washington, D. C. 1914.

Weir, J. R. Some factors governing the trend and practice of forest sanitation. *In* Forestry Quart., v. 13, no. 4, p. 489. 1915.

Meinecke, E. P. Forest pathology in forest regulation. U. S. Dept. Agr. Bul. 275, 62 p. 1916.

Weir, J. R. Larch mistletoe: Some economic considerations of its injurious effects. U. S. Dept. Agr. Bul. 317, p. 24. 1916.

Weir, J. R. Mistletoe injury to conifers in the Northwest. U. S. Dept. Agr. Bul. 360, p. 33–37. 1916.

always remains a great danger of infection spreading to the young stock, with consequent loss. This has been shown in several recent cases where forest nurseries were located in close proximity to diseased trees and alternate hosts. At the forest nursery at Haugan,

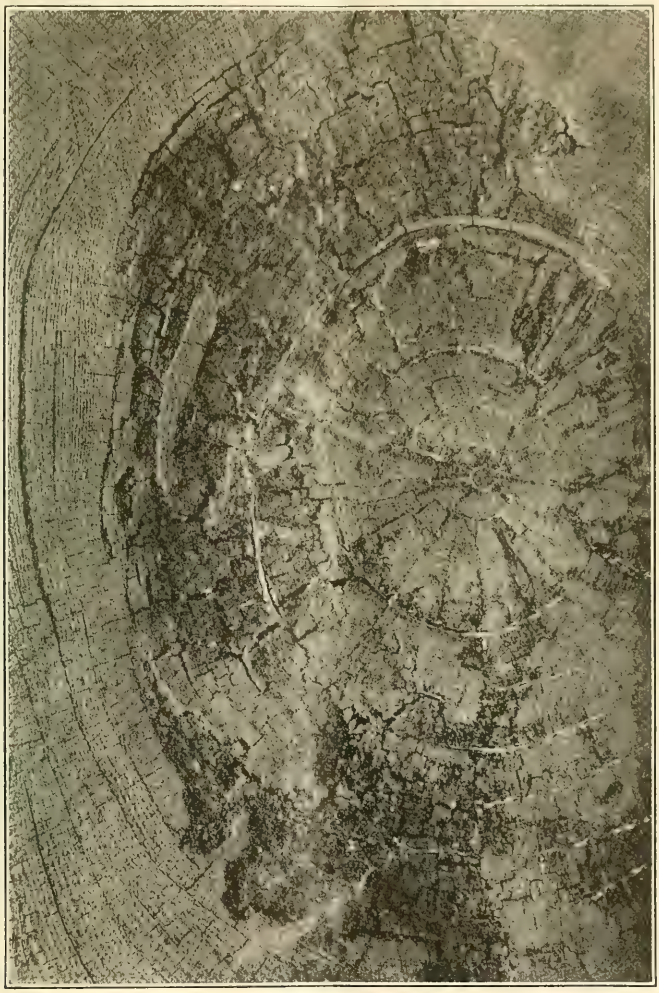

FIG. 12.—*Fomes officinalis*, chalk fungus, showing typical rot in lodgepole pine. Note the white mycelium in the cracks. (Photographed by G. G. Hedgcock.)

Mont., yellow-pine seedlings became seriously infected with *Cronartium coleosporioides* (*Peridermium filamentosum* Pk.). The disease was transmitted by means of the alternate form of the rust occurring on the Indian paintbrush (*Castilleja miniata* Dougl.), which was found growing at the very edge of the nursery beds.[1] A survey of

[1] Weir, J. R., and Hubert, E. E. A serious disease in forest nurseries caused by Peridermium filamentosum. *In* Jour. Agr. Research, v. 5, no. 17, p. 781–785. 1916.

the site, made at the time the nursery was contemplated, would no doubt have resulted in the discovery of the same rust upon the nearby lodgepole pines as well as upon the Indian paintbrush plants, and future losses would have been prevented. The infection with a needle fungus[1] of Douglas fir seedings at the Boulder nursery, Boulder, Mont., and the occurrence of a mistletoe upon the seedlings[2] were due to these diseases being extremely prevalent upon the surrounding native trees of this species. The young and crowded seedlings became ready hosts for the fungus, and considerable damage resulted.

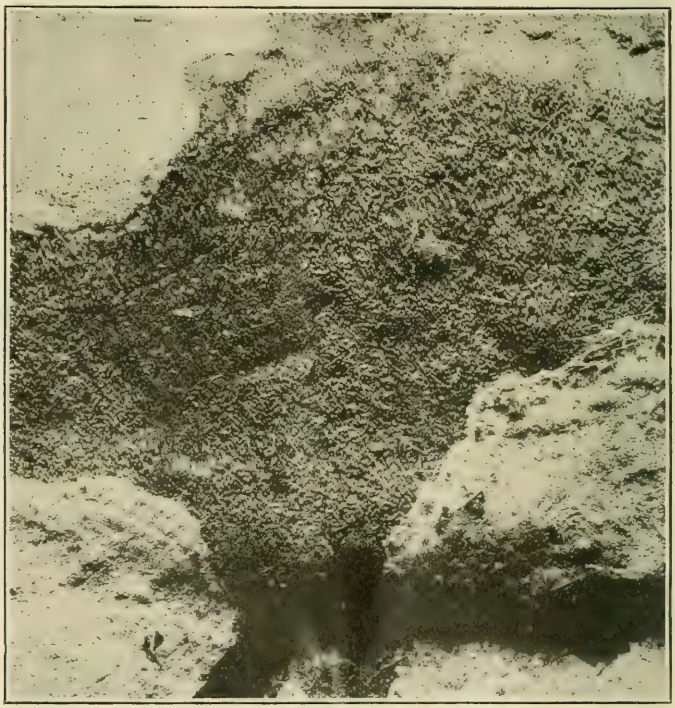

FIG. 13.—*Poria weirii*, brown-cedar poria. Fruiting surface.

In the State nursery at Roscommon, Mich.,[3] a similar proximity of native infected trees and susceptible nursery stock resulted in a serious epidemic.

No less care should be taken with proposed plantation sites upon burned-over or cut-over areas. A disease survey should be made

[1] Weir, J. R. A needle blight of the Douglas fir. *In* Jour. Agr. Research, v. 10, no. 2, p. 99–103, 3 figs. 1917.

[2] Weir, J. R. Mistletoe injury to conifers in the Northwest. U. S. Dept. Agr. Bul. 360, p. 35. 1916.

[3] Kauffman, C. H., and Mains, E. B. An epidemic of Cronartium comptoniae at the Roscommon State Nurseries. In 17th Ann. Rpt. Mich. Acad. Sci., 1915, p. 188–189. 1916.

upon all such areas in which the newly transplanted seedlings are subject to infection by fungi or mistletoe. Many of the plantation sites of this region are located upon burned-over areas, and the majority of these are so badly fire swept that very little has been left in the form of coniferous hosts for forest-tree diseases. However, to review the succession of plant life on a burned-over area, after a fire which has been sufficiently intense to destroy every vestige of humus and litter, is to find that the alternative hosts of some viru-

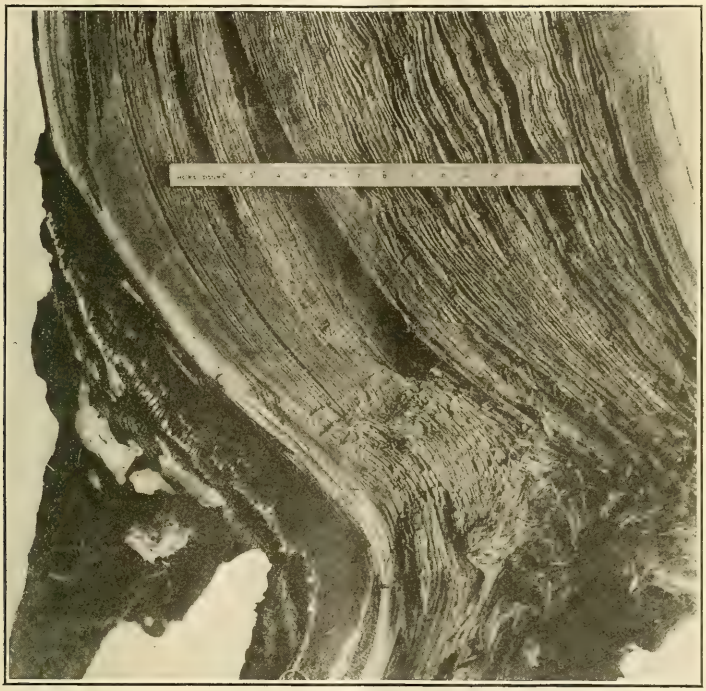

FIG. 14.—Typical rot of brown-cedar poria in butt and roots of cedar. Note the laminations of the rot and (on the left) the fruiting of the fungus.

lent needle or twig diseases have invariably appeared. In many cases the new plant succession carries with it alternate host plants of important forest-tree rusts which soon bear their parasitic fungi, and some of these are found to menace the young tree growth upon the area. A disease survey of such a site is very necessary, especially if the site is to be used as a plantation area for susceptible seedlings.

DISEASE-SURVEY METHODS.

The most practicable methods only are to be applied by unit crews in gathering forest-disease data. These methods should be applied with a reasonable knowledge of the principal destructive disease

agencies, such as fungi, mistletoes, smoke, frost, wind, and snow injury, their outward recognition, and their possible and actual damage to the trees. Sample plats of small dimensions can often be resorted to in order to ascertain the extent of a heart-rot in a certain age class. Borings can be made with an increment borer on a few sample trees and thus the kind of rot and in the case of butt rots the extent of decay can be determined. Soundings on the trunk, the presence of sporophores, the number of dead branches or in-

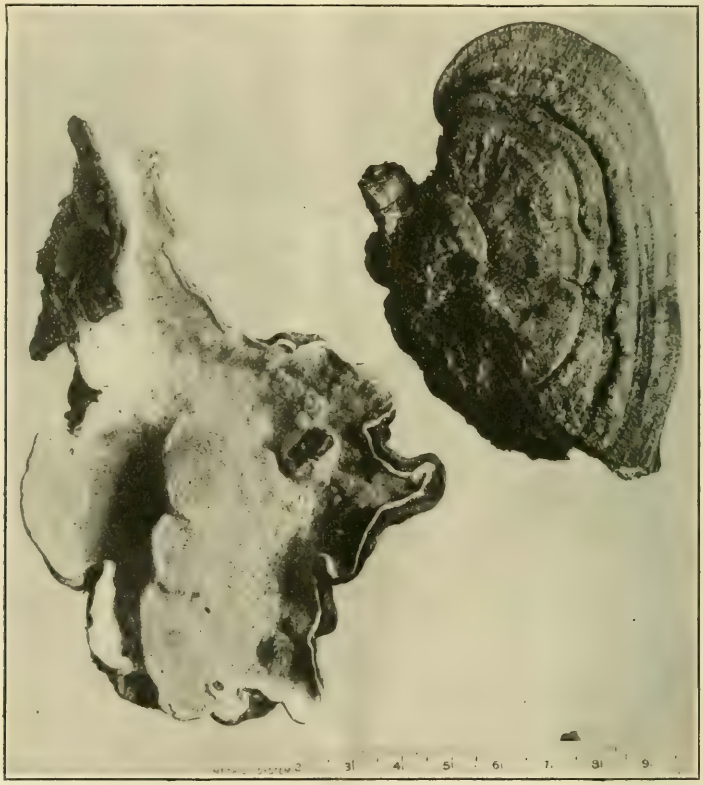

FIG. 15.—*Fomes annosus*, root Fomes. Typical fruiting bodies.

juries, and the presence of the unmistakable swells and pitch flows occurring at old branch whorls all aid in the determination of the presence and extent of decay within a tree. The amount of decay bears a certain relation to the age of a stand, becoming greater as the stand grows older.

Owing to this fact, a table similar to the cull table given on page 25 of the Reconnaissance Manual of District 1, United States Forest Service, but giving the rot percentage only for a range of age classes for each tree species would prove of value in judging the decay in the stand. Such a table would give a range in rot percentages to be

found in a certain age class, a certain site (slope and bottom) for a given tree species for a given kind of rot, and would be compiled from intensive field studies made upon felled trees. It would properly be termed a "table of rot percentages" and would be used by the estimator of each unit crew to determine the rot percentages for each type of forest encountered. Further deductions for other defects could then be estimated and the total cull percentage secured by the addition of the rot percentage. In conjunction therewith, another table giving (1) the class of defect, (2) common name of the defect, (3) the fungus causing it, (4) the various tree species affected, (5) the general external and internal characteristics of the defects, and (6) the average extent of the rots and the general form of the rot within the tree would be of great service to the estimator. Such a table prepared from field data secured during the past three seasons is here submitted. (Table I; figs. 2 to 23.)

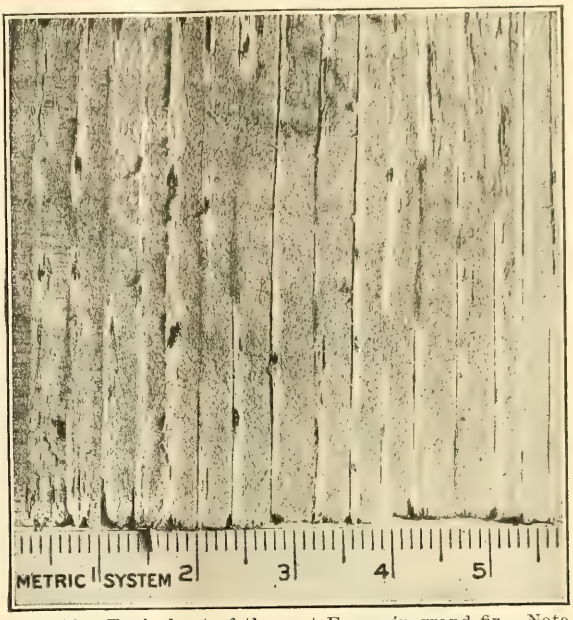

FIG. 16.—Typical rot of the root Fomes in grand fir. Note the black dots in the white areas.

FIG. 17.—*Pholiota adiposa,* the scaly Pholiota. (After Freeman.)

TABLE I.—*Decay determinations for standing trees for the use of estimators and marking officers.*

[Abbreviations: AF=alpine fir, C=western red cedar, DF=Douglas fir, ES=Engelmann spruce, GF=grand fir, L=western larch, LP=limber pine, LPP=lodgepole pine, MH=mountain hemlock, WBP=white-bark pine, WH=western hemlock, WP=western white pine, YP=western yellow pine.]

Class of defect.	Common name for the defect.	Causal parasite (scientific and common names).	Trees generally attacked.	External signs of decay or defect.	Characteristics of decay.
Trunk-rot, occasionally acting as butt-rot; generally patchy.	Honeycomb rot. (fig. 3).	Trametes pini, ring-scale fungus (fig. 2).	WP, YP, LPP, WBP, LP, ES, WH, MH, AF, GF, C, DF, and L.	Typical fruiting bodies of the fungus on the tree; indications at old branch whorls, either by swells or by brownish punky substance, that fruiting bodies have dropped off; soundings made on the trunk to detect hollowness or punkiness, indicating decay; many injuries of various kinds; presence of typical rot: catfaces at the base induce the butt-rot form.	Heart-rot in resinous trees; heart-rot or sap-rot in trees of little or no resin: in early stages, reddish color in split section, with small or large white elliptical patches, punky, soft, brown (discolored); in cross section, small white patches mingled with pitted areas and in advanced stages ring scaled, annual rings separated; delignifying rot, viz. converting wood to cellulose; white-rot; conical in both directions from the area of greatest decay in trunk; as butt-rot, conical, tapering at upper limits; often as patchy areas not uniformly attacking the heartwood.
Trunk-rot (uniform, circular); entire tree.	Stringy brown-rot (fig. 4).	Echinodontium tinctorium, Indian-paint fungus (fig. 4).	AF, GF, WH, and MH.	Typical fruiting bodies of the fungus on the tree; indications at branch whorls, either by swellings or by deep rusty-red punk knots, that fruiting bodies have dropped off; large number of dead branch stubs, accompanied by pronounced swellings at whorls; deep rusty-red color in old branch stubs; soundings made on the trunk; many injuries, such as logging scars, fire scars, blazes, etc.; presence of typical rot.	Uniform heart-rot (confined to given tree species almost entirely); in early stages, wood spongy, yellow stained; typical stage, soft, stringy, brownish to rusty red in color, knots showing a deep rusty-red color: sawed surface (cross section), pitted, broken, and stringy, with reddish brown discolorations, often hollow rotted; carbonizing rot, viz, reducing cellulose, producing dark-colored decay; conical in both directions from the area of greatest decay; very uniform in occupying most or all of the heartwood.
Butt-rot, from roots up to 12 feet into first log (uniform, circular); usually 5 to 6 feet up.	Cubical butt-rot (fig. 6).	Polyporus schweinitzii, velvet-top fungus (fig. 5).	WP, YP, LPP, WBP, LP, DF, GF, AF, and C.	Typical fruiting bodies of the fungus on the ground near the tree (nearly always partly covered by débris), sometimes found as bracket fungus issuing from injuries at the base of the tree (never high up on the trunk); indications of brown-rot in the exposed roots; soundings on the basal portion of the tree and on exposed roots; presence of typical rot.	Uniform heart-rot of butt of tree (also enters roots); in early stages, light reddish brown; typical stage, reddish brown; pronouncedly cubical, crumbly, and brittle when dry; occasionally with thin resinous crusts of white feltlike material (mycelium); odor of turpentine; carbonizing rot; conical from the base of the tree upward; uniform, usually not advancing beyond first log.

Trunk-rot (uniform, circular).	Brown crumbly rot, (fig. 8).	Fomes pinicola, red-belt fungus (fig. 7).	All the important conifers, principally L, WH, MH, AF, and GF.	Typical fruiting bodies of the fungus on the tree; typical rot at old branch stubs; soundings made on the trunk; presence of typical rot.	(1)
Do	Reddish brown heart-rot (fig. 10).	Polyporus sulphureus, sulphur fungus (fig. 9).	Almost all important conifers, principally L, DF, YP, ES, and WP.	Typical fruiting bodies of the fungus on the tree; soundings made on the trunk; presence of typical rot.	Uniform heart-rot; in early stages, light brown, typical stage, dark reddish brown; brittle when dry, crumbly (not pronouncedly cubical), with thick felty mycelial masses in clefts, star shaped in cross section; carbonizing rot; conical, uniform.
Trunk-rot (entire tree); in YP occupies upper part of the tree.	Reddish brown heart-rot (fig. 12).	Fomes officinalis, chalk fungus (fig. 11).	All important conifers, principally L, YP, DF, and ES.	Typical fruiting bodies of the fungus on the tree (the principal means of distinction between rots of this species and that of the sulphur fungus); soundings made on the trunk; presence of typical rot.	Uniform heart-rot; in early stages, light brown; typical stage, dark reddish brown, brittle, dry, crumbly, with thin felty mycelial masses in clefts; carbonizing rot; conical, uniform.
Butt-rot; from roots up to 8 feet into butt log.	Yellow laminated rot (fig. 14).	Poria weirii, brown cedar poria (fig. 13).	C and eastern arbor vitæ.	Typical fruiting bodies of the fungus on the tree (in the root crotches often cementing the forest débris about the roots into a punky mass); soundings at the base of the tree and on exposed root spurs.	Uniform heart-rot; light-yellow color; decayed spring wood separating annual rings in advanced stages, brown felty myce; lium between layers; carbonizing rot; conical, uniform.
Butt-rot (uniform, circular); from roots up to 8 feet into butt log.	White spongy rot (fig. 16).	Fomes annosus, root Fomes (fig. 15).	ES, WP, YP, LPP, WBP, LP, WH, MH, AF, GF, C, DF, and L.	Typical fruiting bodies of the fungus in the root crotches, usually covered up; resin flow at the base of the tree or roots; soundings at the base of the tree and on exposed roots.	(2)
Trunk-rot (uniform, circular).	Yellow heart-rot (fig. 18).	Pholiota adiposa, scaly pholiota (fig. 17).	GF, AF, WH, MH, ES, and WP,	Typical fruiting bodies of the fungus on the tree; soundings made on trunk; presence of typical rot.	(3)
Burl injury	Mistletoe burls (fig. 20).	Razoumofskya spp., mistletoe (fig. 19).	YP, LPP, WH, MH, L, and DF.	Typical mistletoe plants upon branches and twigs; witches'-brooms; conspicuous swellings on the trunk or branches.	
Galls and cankers	Pine cankers (fig. 23)	Cronartium coleosporioides, gall and blister forms; Cronartium comandrae, pine rust (figs. 21 and 22).	YP and LPP	Presence (during months of May to August) of orange-yellow, powdery masses on pronounced swellings; catfaces or cankers of trunk and branches, absence of mistletoe plant upon galls and cankers.	When fruiting stage is inconspicuous during May to August, a light chipping of bark on swellings and cankers will disclose orange-yellow powder or fruiting layer.

[1] Uniform heart-rot, found principally in dead standing and down timber; occasionally acting as heart-rot in living trees by gaining entrance through injuries; in early stages, rot light brown; typical stage, reddish brown, cubical, crumbly and brittle when dry, white feltlike layers of mycelium between cubical patches; felt patches larger, thicker and nonresinous as compared to those of the velvet-top fungus; carbonizing rot; conical, uniform.

[2] Uniform sap-rot and heart-rot of butt: in early stages, ranging from lilac to reddish in color; typical stage, whitish areas separated by smaller areas of sound wood (not prominently pitted), occasionally with black dots in center of white areas; in last stages, annual rings separated, finally spongy; fine felty masses (mycelium) under bark scales; delignifying rot; conical, uniform, filling heartwood and part or all of sapwood.

[3] Uniform heart-rot (principally of trees with little or no resin); in early stages, a light-yellow stain; typical stage, yellow or honey color, brownish streaks; yellowish to light tan or white felty masses running across the grain and breaking up in last stages and separating annual rings, finally becoming hollow rotted; carbonizing rot; conical in heartwood.

It is readily seen that Table I will aid greatly in determining the rot in the tree by means of external characters, and after the class of defect and the cause have been determined by its use it will be comparatively easy to select the proper rot column in the table of rot percentages for any one tree species. In this manner the two tables can be used conjunctively in securing a more accurate rot percentage for the stand.[1] Until it is possible to obtain accurate data from a large number of trees of all the species composing the prevalent forest types of this region, no table of rot percentages will be presented.

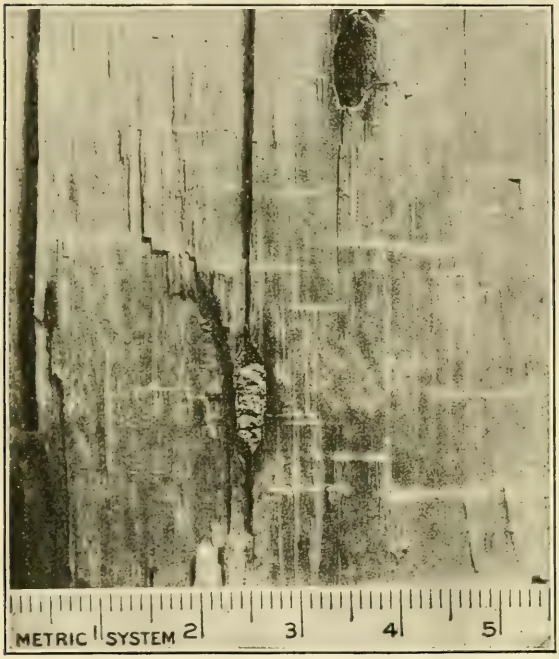

FIG. 18.—Typical rot of the scaly Pholiota in grand fir. Note the horizontal streaks formed by the yellowish felty mycelium.

Since the type lines are sketched on the topographic map on the basis of age class, it will be found advantageous to study and record the rot data upon such a basis. This will make it easier to produce pathological maps of the area by using white prints from the type-sheet tracings of the timber survey maps.

In a unit crew consisting of two men (an estimator and a topographer), the estimator can be trained to determine the cause of the disease and the amount and therefore the rot percentage, recording such data accurately for the strip which is being surveyed. Since the estimate sheets have blank spaces for the recording of all disease and other injuries suffered by the stand, as well as for the estimated loss in cull due to each, the only change that a more intensive disease survey will incur will be the additional work done by the topographer. He will be required to indicate upon his map the boundaries

[1] Weir, J. R. Difficult problem of the control of fungus diseases in the forest. *In* Timberman, v. 14, no. 9, p. 27–29, illus. 1913.

Weir, J. R. Some problems in conservation with reference to forest hygiene. *In* Timberman, v. 14, no. 11, p. 28–31, illus. 1913.

Meinecke, E. P. Forest tree diseases common in California and Nevada. Washington, D. C. 1914. These publications may be found useful in the determination of various kinds of defects.

of the various infections and to show therein the estimated cull due to each. This information can easily be secured by coobservation with the estimator, who can supply the actual figures for the rot percentages and aid in determining the boundary lines of infection. This will produce sufficient reliable data upon which to base valuable pathological maps, which can be compiled either with colored areas to indicate the diseases and inclosed figures indicating the rot percentages or can be drawn in black and white, using lines dif-

FIG. 19.—*Razoumofskya campylopoda*, mistletoe, on yellow pine.

fering from type lines to indicate the boundaries of the infected areas and placing the rot percentages in figures within this area.

PATHOLOGICAL MAPS.

Maps indicating the distribution of diseases in forest areas have not been used to any great extent. In German literature, articles are to be found dealing with plant diseases which have such maps illustrating the distribution of the disease. Very few contain maps dealing with the distribution of forest-tree diseases and none at all dealing strictly with the distribution of fungous infection in forests.

In this country considerable use has been made of disease-distribution maps by the various workers along the line of plant and forest

pathology. This is noticeable in the work done in the study of the chestnut-blight fungus[1] and in the study of two of our important forest-tree rusts.[2] These are all maps of the plain black-and-white type, showing by means of symbols the localities where infection was reported and thus indicating the distribution of the disease. The earliest colored maps used in forest-disease investigations are found in German literature and deal mainly with the distribution of zones of timber damaged by smelter fumes.

FIG. 20.—Mistletoe burl affecting one side of larch log. Size of burl, 3½ feet long by 13 inches in diameter. The cull equaled 25 feet board measure.

Colored maps giving the distribution of smelter-smoke damage were published in a book on smoke damage to vegetation by

[1] Rankin, W. H. Field studies on the Endothia canker of chestnut in New York State. Phytopathology, v. 4, no. 4, p. 237. 1914.

[2] Spaulding, Perley. The blister rust of white pine. U. S. Dept. Agr., Bur. Plant Indus. Bul. 206, 88 p., 2 pl. (1 colored). 1911. Bibliography, p. 61–78. Map showing distribution of blister rust in Europe, p. 14.

Hedgcock, G. G., and Long, W. H. A disease of pines caused by Cronartium pyriforme. U. S. Dept. Agr. Bul. 247, 20 p. 1915. Literature cited, p. 20. Map showing distribution of Cronartium pyriforme, p. 8.

Schroeder and Reuss in 1883.[1] Other works by Schroeder and Schertel in 1884[2] and Borggreve in 1893[3] also give maps in connection with studies of smoke, the latter maps being uncolored. No references were found which contained colored maps of the distribution of forest-tree diseases.

In the making of timber-survey maps, type boundaries are indicated by continuous dotted lines inclosing within the areas so formed the figures indicating type mixture, density, and age class, the age class also being separated by dotted lines. Very often these areas are colored by the use of wash inks or crayons, so as to make a greater distinction between them. A number of standard colors are used and are applied upon white prints, which are found to give the best results. A similar method is proposed for use in making pathological maps, the only variation being the addition to the type-sheet maps of boundary lines indicating the infected areas and a special set of colors indicating various diseases. In the pathological maps only those colors denoting the various infections should be used, leaving the type areas uncolored.

FIG. 21.—*Cronartium colcosporioides*, pine rust, gall form, on young lodgepole pine. The two galls on the main stem are fruiting. Note the small white cups scattered over the surface of these two galls.

[1] Schroeder, Julius von, and Reuss, Carl. Die Beschädigung der Vegetation durch Rauch und die Oberharzer Hüttenrauchschäden. 333 p., 2 maps (colored). Berlin, 1883.

[2] Schroeder, Julius von, and Schertel, A. Die Rauchschäden in den Wäldern der umgebungder physikalischen Hüttenwerke bei Freiberg. Separat-Abdruck Jahrb. Berg. w. Hüttenw. Königr. Sachsen, 1884, p. 93–120, map (colored). 1884.

[3] Borggreve, B. Rauchbeschädigung in dem von Tiele Winkler'schen Forstreviere Myslowitz-Kattowitz. 236 p., 2 maps. 1893.

The maps will be found valuable not only as an interpretation of the data taken in intensive disease surveys in connection with timber surveys but in the appraisal, marking, and general administration of the sale area. With regard to appraisal the map will indicate the location of seriously infected areas and also the rot percentages. With respect to marking, the map will show the exact area of the

FIG. 22.—*Cronartium coleosporioides*, pine rust, blister form, on 2-year-old seedlings of yellow pine.

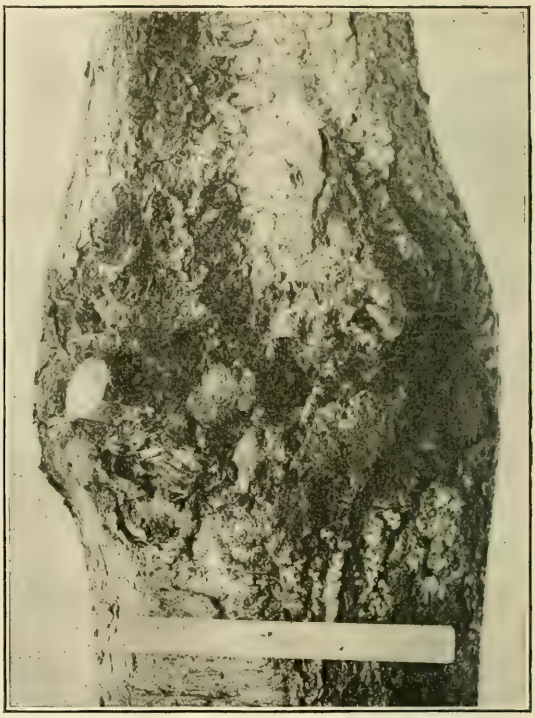

FIG. 23.—*Cronartium coleosporioides*, pine rust, blister form, an old infection, on the main trunk of lodgepole pine, known locally as "hip canker" or "catface."

most seriously infected trees and aid in the exclusion of infected trees for seed trees. From the standpoint of general administration, the maps will show the location of sites and age classes upon which heavier marking must be employed in order to conform with the most effective sanitation clauses.

With regard to reforestation by artificial or natural means, these maps will show the proximity of infected stands and whether or not the site has been or apparently is favorable to excessive disease.

SUMMARY.

Forest disease surveys when carried out in conjunction with timber-survey projects will furnish data of economic value in conducting future sales of the areas in question.

Pathological maps indicating the principal infection areas can be compiled from the data secured by these forest disease surveys.

These maps will be found of practical value in the appraisal, marking, and general administration of the sale area. They will prove of practical use in both artificial and natural reforestation and will also prove useful in indicating the general distribution of forest-tree diseases in our National Forests.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 659

OFFICE OF THE SECRETARY
Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ June 17, 1918

A FARM MANAGEMENT STUDY OF COTTON FARMS OF ELLIS COUNTY, TEX.

By Rex E. Willard, *Agriculturist.*

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This bulletin is based on data obtained in a survey of the business of 120 farms in Ellis County, Tex., in 1914.[1] In this survey the following factors were taken into consideration: Value of farm property; proportion of capital invested in land, buildings, implements, and machinery; feed inventories and cash for operating expenses; labor requirements for all crops, and amount of time available for farm work; receipts from various sources; expenses of all kinds, and miscellaneous minor factors influencing profits.

It must be understood that the records and observations concerning cotton farming in this publication apply to normal conditions before the European war. Due allowance must therefore be made concerning exceptional prices, conditions, and demands relating to agriculture at this time. The business hazard of a system of farming which depends almost wholly upon a single crop for income has been exhibited in seasons of large cotton crops as in 1911 and notably in 1914, with accompanying decline in price to the cost of production or below it, and comparatively low yields of other necessary

[1] Acknowledgment is due Messrs. C. E. Hoke, C. L. Goodrich, A. G. Smith, A. D. McNair, M. A. Crosby, F. D. Stevens, and E. A. Boeger, of the Office of Farm Management, and Mr. Walton Peteet, of the Texas Agricultural and Mechanical College, who assisted in collecting the data presented in this bulletin. Mr. H. H. Bennett, of the U. S. Bureau of Soils, assisted materially in the location of the soils (fig. 2) to which the conclusions of this survey are applicable.

crops which the farmer was compelled to buy at high prices. Besides, a system of one-crop farming as herein described exhausts soil fertility, and in the case of cotton it provides no means for employment of the farmer's time during a considerable part of the year. Incidentally, dependence upon cotton as a sole source of income with which to purchase the ordinary family and farm needs often results in denying the family a sufficient variety of wholesome food. During a considerable period of good prices for cotton this system is profitable if one considers profit to consist only of the returns from the year's operations; but during another period, with low prices prevailing, such a system would be disastrous. This survey, therefore, is to be taken as an analysis of the kind of farm described and as pointing the way to the best results under that system. It is not to be taken as an indorsement of the system, which has many evils, as appears incidentally throughout the bulletin, and as will be more apparent if the system is extended through a long period.

DEFINITIONS AND EXPLANATION OF TERMS

Owner operator.—This system of tenure is one in which the farm property is owned by the operator or manager of the farm. He lives on the farm, and in Ellis County generally does a considerable amount of manual labor.

Owner with cropper.—This system is similar to the owner operator, except that croppers, who receive half the crop which they produce, are utilized in place of hired or wage labor.

Owner additional.—This system is one in which the owner operator rents some additional land, either for cash or share rent, and operates this additional land with the owned land as a unit.

Owner additional with cropper.—A few farms of the owner additional system were found on which cropper labor was utilized on a part or all the owned land. These farms are limited in number.

Share rent.—This system is one under which all the land is share-rented by the operator, who pays the landlord a stipulated proportion of all crops produced. The landlord's customary share is one-fourth of the cotton and one-third of all other crops.

Share-cash rent.—This system is similar to the share rent, except that a part or all the land on which crops other than cotton are raised is paid for in cash rent. All land rented for cotton is on shares.

Independent cropper.—This system is either a system of labor or tenure, according to the viewpoint. In all systems where croppers are utilized the owners furnish the land, a tenant house, and generally a garden patch for the use of the cropper and his family. The land-

lord or operator also furnishes the teams and equipment necessary for the cultivation of the cropper's crops and pays for the ginning of one-half the cotton. In the case of the independent cropper the latter is the manager or operator of the whole farm. In other cases the cropper occupies only a portion of the farm and is supervised to a greater or lesser extent by the owner operator.

Owner, part rented out.—Several farms were found in the survey in which a part of the land owned by the operators was rented out. Such farms are classified as "owner, part rented out," but for the purpose of this survey this land that was rented out was entirely eliminated from the business of the owners.

Available days.—Records were obtained from 28 farms, showing the number of days, by months, that it was possible to do field work. These records were averaged, from which it was found that 211 days per year could be utilized for field labor.

Wage labor.—This term is used to designate the hired or paid labor per farm as distinct from the labor performed by the operator himself, or that of his family, or labor performed by croppers. The term "owner-wage" indicates that a farm is operated by its owner with wage labor and without cropper labor.

Man-labor cost.—This cost is composed of four component parts, namely, cost of hired or paid labor, value of family labor, whether actually paid for or not, value of the operator's own labor, and value of rations bought for or furnished to laborers.

Diversity index.—In order to ascertain to what degree diversification of enterprise is justified by local experience, it is desirable to have a definite means of measuring the degree of diversification on a farm. Such a measure may be determined as follows: First, find the sum of the magnitudes of all the farm enterprises (cost of production was used as representing magnitude), divide the magnitude of each enterprise by the sum above mentioned, square each of the quotients, and divide unity by the sum of these squares. The result is the diversity index.

Animal unit.—An animal unit is a mature horse or cow or as many smaller animals as required the equivalent in feed of a horse or cow, namely, 2 head of young cattle or colts, 5 hogs, 10 pigs, 7 sheep, or 100 hens.

Farm income.—The farm income is the difference between the total receipts and total expenses of the farm, not including interest on investment and value of operator's labor.

Income above rent.—This income is the amount that the operator actually receives for his labor after deducting the rent of the land and interest on his working capital, this interest being computed on the basis of the current rate of interest on vendor's lien notes, which is

8 per cent. This income is a measure of efficiency of farming. In general it varies with the size of the farm.

Percentage returns on the investment.—This term is used to designate the percentage income that the invested capital makes after deducting all expenses. It is determined as follows: The estimated value of the operator's labor is deducted from the farm income and this result is divided by the amount of the capital invested. It was found that on account of the wide variation in price of land between farms of approximately the same value it was necessary to equalize the land values in determining a measure of efficiency which eliminates size of business. Since the variation in price of land has scarcely any relation to the efficiency of farm operation, an average land value of $139 per acre was assumed for the purpose of determining the per cent return on the investment where this measure is used as a standard of efficiency.

AREA SURVEYED.

Ellis County is located in the northeastern part of Texas near the line between what are locally known as Central and North Texas (fig. 1). Waxahachie, the county seat, is approximately 30 miles south of Dallas. The area surveyed extends from north to south through the center of the county and also east from the center toward Ennis.

This area was chosen for several reasons: It was possible to find a large number of farms on the same soil type, i. e., the Houston black clay (fig. 2), thus making it possible to compare farms of similar practice, which is not possible on soils of widely different character; a comparison of census data for the pricipal "blackland" counties shows this to be one of the leading cotton-producing sections of the State; it is one of the oldest agricultural sections of the State, so that quite definite systems of farming have been established in local practice; and, finally, the farms of all of practically the same type. Since these conditions exist, the comparative study of farm organization, costs, efficiency, etc., is made possible.

TOPOGRAPHY.

The general surface of Ellis County is undulating to rolling, being cut by numerous small streams. The area occupied by the Houston black clay soil is generally more level than other parts of the county. The elevation varies from about 450 feet to 750 feet above sea level, Waxahachie being 551 feet.

Practically all of the drainage of the country is toward the south or southeast, through small streams to the Trinity River. Small

streams of the central and western portions come together toward the southern part of the county and join the Trinity south of Ellis County.

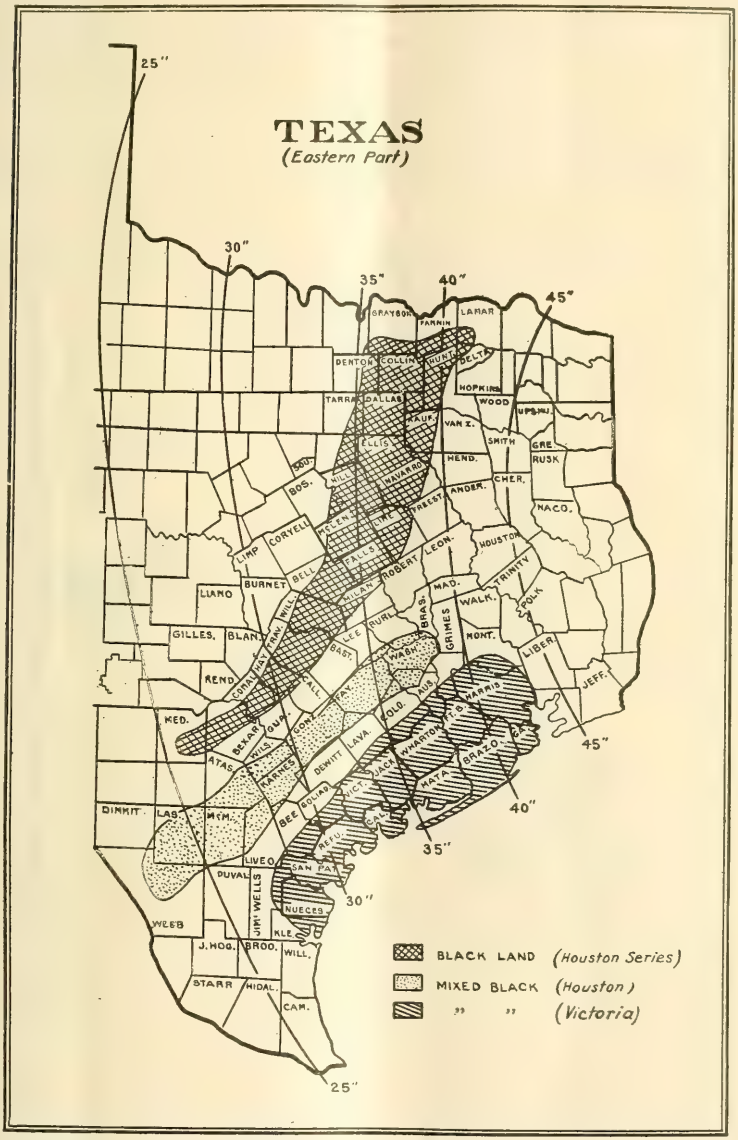

FIG. 1.—Map showing location of black lands of Texas, with lines of equal precipitation.

Most farms of the country are fairly well drained, but there are local areas both on the upland and along the streams that are not. Many areas along the streams, particularly near the Trinity River, are subject to overflow during high water.

SOILS.

The 13 soil types found in Ellis County vary from fine sand to stiff clay. Most of these soils are derived from marls and chalky limestones. The geological formations known as the Taylor Marl and Austin Chalk are the sources from which the Houston black clay is derived. The farms studied in this analysis are practically all located on this soil type (see map, fig. 2), and consequently a somewhat detailed description of this type is given.

The Houston black clay occupies more than one-third of Ellis County. The surface soil, to a depth of 10 inches, is very heavy,

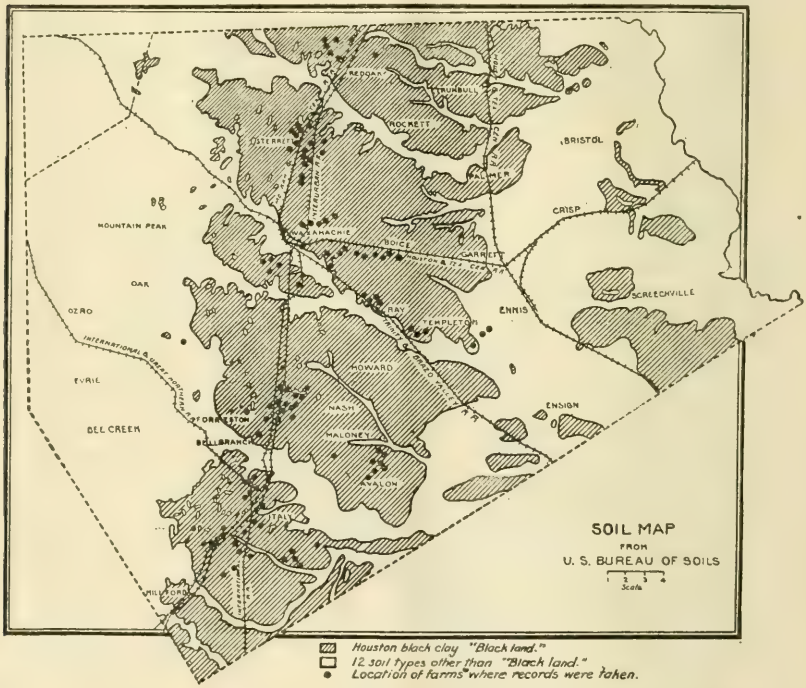

FIG. 2.—Map of Ellis County, showing soils and location of farms studied.

tenacious black clay. The subsoil has practically the same characteristics as the soil, although it is a little lighter in color, owing to a smaller percentage of organic matter.

The type is locally known as "black land." When dry and well cultivated it is very friable and easily worked. When plowed too wet it forms clods, but after they have been exposed to the weather for some time they break down to a certain degree and the soil can be put into good mechanical condition again by means of a light harrow. If not tilled the soil cracks badly in dry weather; sometimes the cracks are several inches wide and several feet in depth.

In wet weather, and especially during the winter months, this clay sticks to the wagon wheels in large quantities and it is frequently seen along the roads in piles where it has been removed.[1]

The Houston black clay is well adapted to the growth of cotton, corn, grain, and various legumes. Alfalfa does very well on the more level areas. Various other feed crops yield well when climatic conditions are favorable.

Another and closely related group of soils found in the southern part of Texas (see map, fig. 1) is known as the Victoria series.[2] These soils are more nearly level than the Houston series, but have the same general properties. Where climatic conditions are similar the same crop adaptations are found. Both series contain a high percentage of lime.

An area lying between the "black land" of the Houston series and the Victoria series (see map, fig. 1) contains considerable bodies of heavy black soil between areas of sandy and other light-textured soils. These areas of heavy land may belong to either the Houston or Victoria group.

CLIMATE.

Ellis County has a mild climate. The summers are rather long and hot. In winter the temperature is mild, except during the "northers," which occur at irregular intervals. The "northers" are a continuation of the blizzards of the Great Plains region of the United States and cause very sudden drops in temperature to points considerably below freezing.

The growing season is about eight months in duration, the average date of the last killing frost in the spring being March 21 and the first in the fall being November 10, according to the records of the U. S. Weather Bureau station at Waxahachie. The same authority reports the average annual rainfall as 35.44 inches. The greatest amount of rainfall occurs during May and June, being on the average 5.35 and 3.67 inches, respectively, for these months. Crops in this region suffer to about the same extent from excess rainfall as from drought. Lines of equal rainfall, showing the decrease in annual precipitation from east to west, may be seen on the map. (See fig. 2.)

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[1] "A phase of the type known as 'Elm Thicket' land generally occupies level or gently sloping area paralleling the stream courses. It was originally covered by a dense timber growth, the greater percentage being elm. Though a few of these areas have never been cleared, the greater part has been cleared long enough to be free from stumps. This phase is considered a little more productive than the main body of the type. The soil is deep and very rich in organic matter."—Soil survey of Ellis County, Tex. Field Operations of the Bureau of Soils, U. S. Department of Agriculture, 1910.

[2] Bureau of Soils, U. S. Dept. Agr., Bul. 96, p. 251.

TRANSPORTATION AND MARKETS.

There are five steam railroads in Ellis County. (See fig. 1.) These lines extend generally north and south through the county; one crosses in a northwest-southeasterly direction and one extends east from Ennis. An electric interburban line connecting Waco, McLennon County, and Dallas, crosses the county in a general north and south direction, passing through Redoak, Waxahachie, Forreston, Italy, and Milford. This trolley line does little local business except the carrying of passengers.

The county is well covered with "pike" roads which connect all the principal towns as well as inland points, thus affording easy operation of farm wagons in hauling cotton. Many crossroads are not yet graveled, but these are gradually being improved. The ungraveled roads are practically impassable during wet seasons, so that the "pikes" are a considerable asset to the farmers. These improvements have been brought about by means of the sale of bonds issued for the purpose. About 20 per cent of the farm operators of the region operate automobiles, which is due quite largely to the fact that good roads are available for their use.

More than half the farms studied in this survey are less than 3½ miles from a market point where cotton gins are located. Practically all the farms of the county are less than 5 miles from a market point. Since cotton is a fairly concentrated product and is the chief source of income, this distance of farms from market has comparatively little influence on the price of farm land.

Cotton is usually sold to buyers shortly after it is ginned. The bales are sampled and prices are then quoted based on the market price at Galveston and New Orleans.

The local market for products other than cotton is limited, yet other crops show a higher margin of profit between cost and value, and this fact is suggestive of possibilities of greater profit under other conditions. Cotton cultivation here as in many other regions has developed because cotton is a more dependable crop under hard conditions and with indifferent cultivation, because it is readily salable and suffers comparatively little loss by exposure to weather, and because its effect upon soil fertility has been little appreciated heretofore. Of course, market facilities and commercial influences reflect this development and at the same time encourage it, so that cotton farming has come to be the accepted form of industry.

LABOR.

The farm labor of the county is both white and colored. A large part of the farm work is done by the operators and their families, but the greater part of the cotton picking is done by colored la-

borers—men, women, and children. A class of laborers known as croppers[1] or "half hands" are generally of the white race, but a considerable number are colored. Croppers are employed in handling more than 20 per cent of the cotton of the county. (See Table IV.) The transient labor is practically all colored and remains in the towns, except during the chopping and picking seasons. Cotton picking is done almost entirely by contract, the price paid per hundred pounds being determined largely by the quality and yield of cotton.

AGRICULTURAL DEVELOPMENT.

Ellis County was organized in 1894, being formerly a part of Navarro County. The first settlement was made near Forreston about 1844. The early settlers came chiefly from Tennessee, Georgia, and the Carolinas, and more than half of the present population of nearly 54,000 is directly descended from these emigrants. There are some foreign-born citizens and their descendants in the county, Bohemians, Hungarians, and Germans comprising the greater part of this element. There is a considerable number of negroes in the county, mostly confined to the towns. Prior to 1865 practically the only enterprises were the production of cattle and sheep. Wheat was first produced about 1850, but did not become important until about 1880. During this period grain crops were raised on the upland and cotton made its first appearance in the bottoms along the streams. All crop land was under fence until 1901, when the fence law was repealed. Alfalfa was first raised in the bottom of Mustang Creek in 1890 and in 1896 it was produced in the Elm Thicket section.

A very little cotton was produced in the county before 1860. The first gin in operation consisted of a handmade two-roller outfit run by hand. This was superseded by a power gin about 1881. From the very beginning of the production of cotton the acreage of this crop has increased, entirely supplanting the range at the present time. The boll weevil caused some damage in Ellis County about 1903, following which considerable more attention was given to feed and grain crops. From this period to the present, however, there has been little damage to cotton from this source.

Table I shows the trend of development in Ellis County from 1850 to the present. The area of the county is 587,520 acres, of which only 2,600 acres were improved land in 1850. From that date to the present the development of crop farming has been rapid and uniform, 446,194 acres being improved in 1910. Cotton has held the largest place in the cropping system, developing from 52,172 acres in 1880 to 274,666 acres in 1910. Corn has made advances parallel with

[1] For definition of cropper see p. 2.

cotton, except that the 1910 period shows a marked decrease in acreage, but at no time has this crop equaled cotton in extent. Oats and wheat have increased markedly in acreage, but these have likewise fallen off in extent in the 1910 decade.

TABLE I.—*Agricultural statistics for Ellis County, Tex., from the reports of the United States census, 1850–1910.*

	1850	1860	1870	1880	1890	1900	1910
Total area of county (acres)	.....	.....	.....	.....	.....	.....	[a] 587,520
Acreage of improved land	2,600	23,636	28,201	204,506	303,910	394,968	446,194
Cotton:							
Acreage	(b)	(b)	(b)	52,172	103,629	197,828	274,666
Production (bales)	.....	359	2,960	18,956	42,701	91,298	77,141
Corn:							
Acreage	(b)	(b)	(b)	42,899	57,568	99,598	62,573
Production (bushels)	28,744	119,918	312,843	577,121	1,715,798	3,203,600	915,267
Oats:							
Acreage	(b)	(b)	(b)	5,533	13,265	27,232	2,061
Production (bushels)	1,315	31,591	16,076	153,527	299,444	1,014,750	26,617
Wheat:							
Acreage	(b)	(b)	(b)	18,500	11,260	34,264	368
Production (bushels)	945	88,345	11,943	176,215	103,847	503,730	1,914
Number of—							
Horses	309	7,803	7,387	12,942	14,992	13,033	9,796
Mules	.....	.....	776	2,758	5,463	11,620	14,272
Dairy cows	937	7,604	3,892	8,809	10,639	9,783	8,054
Other cattle	1,752	51,761	21,211	29,981	24,400	19,889	7,749
Sheep	259	17,539	3,007	1,857	818	907	1,174
Swine	2,858	10,947	8,171	15,097	26,347	58,756	20,214

[a] Bureau of Soils, U. S. Dept. of Agriculture. [b] No data.

Horses increased in number from 1850 to 1890, but from 1890 to the present the number has fallen off, the horses being replaced by mules. The latter were noticeable first in 1870 and have continuously increased to the present. The total of mules and horses has increased each decade to 1900, since which time the number has remained at about 25,000 for the county.

Dairy cattle have never been numerous in the county, but range or beef cattle became quite numerous in the 1860 decade. From that time to the present beef cattle have decreased, the range being taken up by crop farming. Sheep, while not numerous, reached their maximum at about the same time as beef cattle and have generally declined since. Swine, never very prominent, reached their maximum in the 1900 decade.

The foregoing data show that stock raising on an extensive scale has been supplanted by crop farming since 1860. Practically all the land capable of tillage has been brought under cultivation, and cotton holds the important place at the present time.

REAL ESTATE VALUES.

Since Texas became a State all public lands within her boundaries have remained under State control. Title to land before the Mexican War was derived from the Spanish and Mexican Governments.

In consequence, all surveys were made using Spanish units of measure, the square league, "legua" (4,428.4 acres) and "labor" (174 acres), being the common measures of area. It was the custom in making surveys to use natural lines such as streams or coast lines as bases, giving the land units frontage on these natural features. Consequently there is little regularity either in shape or size of the various units. Land lines, therefore, have no relation to magnetic north and south (except in the Panhandle section of Texas).

Tracts of land acquired as Spanish grants have since been subdivided and sold in smaller area at prices as low as 50 cents per acre. Texas public land has been sold as low as $2.50 per acre. However, as the development of cotton farming took place land values advanced rapidly. The average selling price of land as represented by this survey of 115 farms of Ellis County was $139 per acre in 1914. This price was arrived at by asking each farmer what he considered a fair commercial valuation for his land with its improvements, and was verified by prices received in local sales of farms.

The census valuation of lands for Ellis County as a whole was, for 1910, $59.90 per acre. The wide discrepancy between this figure and that reported for the farms visited in this study, is due to several causes. In the first place, census values are usually about the same as assessed valuations, which are usually less than half the current sale values. The census figures also apply to the entire county, while the figures of the survey apply to a selected area in which land values are above the average. Furthermore, during the 4½ years since the census values were obtained, land had risen markedly in value. A comparison of census data for 1880 with those for 1910 shows that on the average for this 30-year period land values in Ellis County increased at an average annual rate of 6 per cent. During the last decade of this period the total increase was more than 100 per cent.

A considerable proportion of these lands are farmed by share tenants. The net rental income from lands thus rented averages $4.80 per acre, which is 3.5 per cent of the average valuation of $139 per acre. From this it might appear that these lands were overvalued, but when the fact is taken into consideration that they were increasing in market price, this appears not to be the case. The owner of land obtains his profits not only from operating income, but also from increase in market price of the land. We have already seen that the latter source of profit has averaged 6 per cent annually for 30 years past. When this is added to the 3.5 per cent profit from operation, there is a total profit on the investment of 9.5 per cent. Local land values appear, therefore, to be justified from the standpoint of the investor. He is, in fact, making a fair profit on his investment, and it is this fact, in part, that gives these lands their mar-

ket value. Similar conditions prevail in other good agricultural areas, especially in the Middle and Western States.

That farm lands in this county will continue to increase in price at these high rates for an indefinite period is hardly to be expected. However, they may continue to do so for some time. During the last census period the area of crops in the United States for which acreage is reported increased only 9.9 per cent, while population increased 21 per cent. During this same period the prices of farm products increased on the average 67 per cent. Further increase in the market price of farm products will have a tendency further to increase the price of farm land.

Another reason why the price of farm land is usually such that the operating income from it is only 3½ or 4 per cent, lies in the fact that the ownership of land is distinctly advantageous for many reasons. Because of the fact that investment in land represents an almost absolute security from loss of capital, owners are willing to accept a low rate of interest on their investments. The independence of the landowner is worth much to the average man. The land furnishes a permanent abiding place—a home—with all that this means to the average citizen. Men will therefore pay a relatively higher price for farm land than they will for most other investment properties bringing the same income.

In Table II are shown the average prices of land operated under three types of tenure. It will be noted that the income per acre to owners where land is rented for cash represents but 2.4 per cent on the investment of the owners, but as only a very small portion of the crop area of any farm in this group is rented for cash, these returns do not represent actual incomes from farms. The average percentage return on the investment for the 115 farms included in these studies,[1] when converted to a uniform basis of operation for comparison, is 6.3 per cent.

While the working owners make a very satisfactory income on the investment, the landlords whose farms are operated by tenants are satisfied with a very much smaller return. They do not expect so large returns because of the security of investment and expected profits from advances in land prices in the future. The satisfactory incomes of owners cover all the risks of farm operation, while the returns to landlords from their land covers only a very small portion of the risk, the greater part being borne by the tenants.

[1] Five of the 120 records taken were discarded. Only 114 records furnished complete records on cost of production. In some of the tabulations only 109 records were used.

TABLE II.—*Value of land operated under different tenures and income to the owners of the land, Ellis County, Tex., in 1914.*

	Value per acre.	Gross income per acre for owner.	Net income per acre for owner.	Per cent return on investment of owners.
37 working owner farms	$151	$26.40	$11.89	5.9
24 share rent farms	137	6.18	4.80	3.5
18 share-cash rent farms	141	6.42	5.04	3.6
18 share-cash rent farms (cash rented land)	141	4.82	3.44	2.4

From the standpoint of the tenant or other individual who has a limited amount of capital, but who desires to become a landowner, it is very important that a close approximation of the earning value of the land be known. When this value is known it is possible for the prospective buyer to determine what portion of the cost price must be paid at the time the land is bought and how much may be met from the earnings of the land. It is, however, highly important that the tenant farmer should look forward to the time when he can make a sufficient first payment on a farm to render it possible for

FIG. 3.—Proportionate capital invested in various items (average, 115 farms, Ellis County, Tex.).

him to become an owner. Ownership is greatly to be desired because of its effect upon industry and citizenship. The sense of possession and the inducement to save in order to own a home warrant extraordinary effort if a considerable initial payment can be made and reasonable rates of interest can be obtained.

The graph (fig. 3) shows the average distribution of capital at the present time as indicated by the records of 115 farms of Ellis County. Land represents 82.6 per cent of the total farm investment. Dwellings represent 5.8 per cent, while other buildings such as barns, tenant houses, sheds, etc., represent 2.6 per cent of the total. The remaining working capital, consisting of stock, machinery, feed and supplies, and cash to run the business, amounts to 9 per cent of the investment.

NORMAL CONDITIONS.

It is appreciated that definite conclusions regarding farm business can not be drawn unless practically all conditions are near the average for a considerable period of years. The records of this survey

cover the farm business for the calendar year 1914. Two factors affecting results were not normal, namely, the price received for cotton and the yield of oats.

To overcome the discrepancy in the price of cotton, the average price received for the 5 years previous to 1914 was obtained from each farmer. The average of these data shows that under normal market conditions the price received was 11.2 cents per pound. Therefore, in all calculations where receipts from cotton are considered, the average 5-year price per pound has been substituted. This price is far below that now prevailing. Present prices are due to a great war, and can hardly be expected to continue when conditions have become normal again.

On account of drought conditions during the early summer of 1914, the oats crop was practically a failure. More than two-thirds of the oats planted for grain were cut for hay and very low yields were obtained for this feed. Since it is impracticable to determine increased labor and other costs due to increase in yield as well as increased returns from this enterprise, no definite conclusions are drawn concerning oats. However, since oats occupied only 6.9 per cent of the total acreage in crops, it is thought that this discrepancy will not vitiate the general results of the survey.

Comparison with census data and consistent statements from farmers indicate that practically all other important factors of the farm business were normal during the year 1914.

TENURE.

The tenure problem is an acute one in Ellis County, as it is in Texas generally. A complete analysis of the problem would require a large amount of information concerning each tenure system. Since records were obtained from only 114 farms, when these are grouped according to tenure there are not enough farms in each system to make fair averages.

Seven more or less distinct tenure systems[1] were encountered in the survey, the number of farms in each group being as follows: 37 owner-operators, 11 owners-additional, 16 owners with cropper labor, 5 owners-additional with cropper labor, 24 share renters, 18 share-cash renters and 3 independent croppers. These make a total of 114 farms on which tenure and cost tabulations were made. The owner-operator farms and the owner-with-cropper-labor farms might each be further subdivided, since operators were found in each of these groups who rented out a part of the land owned. However, in the data here given the latter classification is not con-

[1] For definitions of the tenure systems see p. 2.

sidered, the land rented out being eliminated entirely from the business of the farms operated by the owners.

No farms were encountered in this survey which were rented entirely for cash, all rented land in cotton being operated on the share basis. This condition may be accounted for as follows: A glance at the curve in figure 9 (p. 32) shows that from 1903 to 1914 three crops of cotton were failures or nearly so, namely, those of 1905, 1907, and 1909, which is a failure once in four years on the average. Where there are frequent failures, and where there is such a wide variation in yield (310 pounds in 1906 to 125 pounds in 1909), as indicated by the curve above referred to, it is impossible to establish any cash rental value that will be equitable to both landlord and tenant. Thus it has come about that practice has established that land rented for cotton is on the basis of one-fourth share to the landlord. By this system there is less hardship on either the landlord or tenant from a failure of the crop, a matter over which neither has any control. Where a large yield is secured, the landlord makes a high rent and the tenant gets proportionately high returns. When the yield is poor, both share the misfortune, but the tenant's rent is low in proportion to his returns.

The three leading tenure systems, i. e., owner-operator, share renter, and share-cash renter, were found on a sufficient number of farms to justify the drawing of certain conclusions from their averages.

TABLE III.—*Percentage of crop area in different crops under different tenure systems (79 farms, Ellis County, Tex., in 1914).*

Tenure system.	Number of farms.	Per cent of crop area in specified crops.					Per cent of crop acreage in second crops.
		Cotton.	Corn.	Oats (grain).	Oat hay.	Other crops.	
Owner wage	37	67.2	15.2	2.7	5.2	9.8	1.3
Share renters	24	73.7	14.9	2.6	4.6	4.3	.6
Share-cash renters	18	79.0	12.1	1.2	2.7	5.1	.6
All farms	79	72.5	13.3	2.8	3.8	6.5	.8

Table III shows the percentage of crop area in the principal crops under these three leading tenure systems. It is seen that the owner farms have less cotton and more feed crops than farms under either of the tenant systems. Further, the table shows that the owners grow second crops slightly more than do the tenants. On the tenant farms all cotton is share rented and a part or all of the grain and feed crops on the share-cash rent farms is cash rented.

Table IV shows that of the 9,781 acres of cotton produced on these farms, 40.1 per cent is raised by owners with wage labor, 22 per cent

by owners with cropper labor, and 37.9 per cent is raised on share-rented land by wage labor.

TABLE IV.—*Acreage and yield of cotton under different tenures (114 farms, Ellis County, Tex., in 1914).*

	Owner-wage cotton.	Share-rent cotton.	Cropper cotton.	All cotton.
Acreage	3,922	3,707	2,152	9,787
Per cent of total	40.1	37.9	22.0	100.0
Yield per acre (pounds lint)	257	229	231	241

The owner-wage cotton gave the highest yield per acre—257 pounds of lint. Cropper cotton yielded 231 pounds and the share-rented cotton produced 229 pounds of lint per acre. The fact that cotton raised by owners with wage labor yielded best is accounted for partly by the fact that the crop received closer oversight than that produced by cropper labor. Further, the owned land is slightly better in quality than share-rented land, the estimated rent of owner-operated land being $5.19 per acre, while that of rented land is $4.92 per acre.

Table V shows the cost of producing cotton under different tenures and under different labor systems. On 69 farms where owners produce cotton with wage labor, the cost is 8.2 cents per pound. The cost of the owner's half of the crop produced by cropper labor on 24 farms is 9.4 cents per pound, while the cropper's half costs the cropper only 6.8 cents per pound. On 49 farms where cotton land is rented on shares the cost to the landlord for his share of the crop is 8.1 cents and the cost to the tenant for his share is 8.5 cents per pound. On these 49 farms four landlords received one-third of the cotton produced by the tenants, while 45 landlords received one-fourth.

TABLE V.—*Average cost of cotton per pound under different tenures and labor systems (114 farms, Ellis County, Tex.).*

	Owner-wage.	Share-rent wage.			Cropper.			Average of all cotton.
		Landlord.	Tenant.	Average.	Owner-operator.	Cropper.	Average.	
Number of records	69	49	49	49	24	24	24	142
Cost per pound (cents)	8.2	8.1	8.5	8.4	9.4	6.8	8.1	8.3

From the standpoint of cost of production it is seen that the customary rental of one-fourth of the cotton is reasonable and fair. In the half-and-half division of the cotton produced by cropper labor the heavier cost falls on the owner or operator, the difference being 2.6 cents per pound. The margin of profit of the owner's share of

cropper cotton is approximately 1.8 cents per pound, while the margin of profit to the cropper is 4.4 cents per pound.

Two reasons may be cited why owners are willing to stand a higher cost for their share of the cotton raised by cropper labor than the cropper's share costs the cropper. The owners have the alternative of raising cotton with wage or hired labor, or they may employ croppers and allow them half the crop produced as wages. In the first case, the owner must take all the risks in producing the crop, whereas, in the second case, the cropper shares the risk equally with the owner. Further, under the wage system the owner must provide all the man labor and oversee it, whereas with croppers the latter must furnish and oversee the hired labor.

In Table VI, 79 of these farms are grouped according to the capital of the operator. It is a striking fact that every operator with less than $4,000 capital is a tenant, while every one with more than this is an owner; and this in spite of the fact that tenants with an average capital of only $1,200 make nearly as much as owners with $10,000, while tenants with $2,500 invested make distinctly greater incomes than owners with an investment four times as great. These figures indicate clearly that an operator *with small capital* can make a much better income as a tenant than as an owner. Similar results have been found in all farm-management surveys, made in all parts of the United States.

TABLE VI.—*Relation of capital invested by farm operator to income of the operators of owner and tenant farms (79 farms, Ellis County, Tex., in 1914).*

Operator's capital.	Owner farms.				Tenant farms.				
	Number records.	Crop acres.	Average capital.	Farm income.	Number records.	Crop acres.	Average capital.		Farm income of tenant.
							Landlord.	Tenant operator.	
$516 to $1,966					28	91	$13,453	$1,212	$751
$2,015 to $3,237					14	131	20,798	2,375	1,157
$4,709 to $13,665	15	60	$10,112	$850					
$14,203 to $19,548	17	89	17,088	1,398					
$21,106 to $41,360	5	141	31,100	2,278					

From the results shown in Table VI, it would seem probable that the groups of owners having an average capital of about $10,000 could do much better financially if they would rent large farms and operate as tenants. But not a single operator with $4,000 or more capital is doing this. Since, theoretically at least, they could make much larger incomes as tenants, there must be very important reasons why they choose to operate as owners of smaller farms. Generally speaking, wherever surveys of this kind have been made in this coun-

try, just as soon as the tenant accumulates enough capital to make a fair living as an owner, he passes into the owner class, often sacrificing two-thirds of his income in doing so. Table VII shows the corresponding facts for a survey made in Chester County, Pa. In the fourth capital group ($3,000 to $5,000), the majority have become owners, in spite of the fact that the average income of owners in this group is only $521, while that of tenants with similar investments is $1,574. Only six operators with as much as $5,000 capital choose to remain tenants, and not one with more than $9,000. Why, then, do they choose ownership with smaller incomes? The answer to this question lies at the very foundation of rural citizenship in this country.

TABLE VII.—*Sizes of owner and tenant farms and amount of income on 502 farms in Chester County, Pa.*

Amount of capital.	Owners.			Tenants.		
	Number of farms.	Average area.	Average income.	Number of farms.	Average area.	Average income.
		Acres.			*Acres.*	
$1,000 and less				19	42.2	$424
$1,001 to $2,000	3	19.5	$122	46	94.7	640
$2,001 to $3,000	11	21.7	223	34	123.9	815
$3,001 to $5,000	33	37.1	521	19	147.3	1,574
$5,001 to $7,000	60	57.7	819	4	162.8	2,578
$7,001 to $9,000	67	71.1	994	2	136.0	3,276
$9,001 to $11,000	55	94.2	1,169			
$11,001 to $14,000	66	109.6	1,641			
$14,001 to $17,000	47	123.4	2,035			
Over $17,000	36	163.0	2,583			

In the first place, a moderate working capital of, say, $10,000 would suffice for the operation of a very large farm. It is only the exceptional man who is capable of operating such a farm. On a moderate-sized farm the average farm family can do most of the work. As the size of the farm increases there must be increasing dependence on hired labor, which is growing more and more unreliable and difficult to obtain. Most men prefer a smaller farm business in which labor difficulties are much less troublesome. Men who have large holdings in farm land nearly always lease them out in relatively small tracts rather than undertake to operate a single large business unit.

While the difficulty of securing satisfactory labor for the operation of large farms is one of the reasons why men of moderate capital choose to operate as owners of medium-sized farms rather than as tenants on large farms, it is by no means the most important reason. The owner who operates his own farm is absolutely his own boss. He enjoys economic independence. No one can tell him what he shall plant. He is in no danger, provided he keeps out of debt, that anyone shall tell him to move on to make place for somebody else.

He does not have to dicker with anyone about the amount of rent he must pay, or how long he may stay. His home is his castle, in which he is supreme. The average red-blooded American is ready to sacrifice much for these advantages; and who shall say they are not worth what they cost?

But these personal aspects of the case are not the whole story. There is a broader aspect of national import. The tenant farmer, because he is not a permanent resident of the community, takes little interest in the local church, the school, or the condition of the public roads. He does not cheerfully contribute to their proper upkeep. He is not even deeply interested in good local government, because he feels that it is not his concern. He looks to the landowner for the performance of civic duties. He is, in fact, a much less valuable member of society than the farmer who owns the land he tills.

Farm-management studies show unquestionably that the young farmer just starting out with small capital should, for purely financial reasons, operate as a tenant on a moderate-sized farm rather than as owner on a mere garden patch; but they also show that because of the tremendous advantages of ownership, practically all American farmers become owner-operators just as soon as they have acquired sufficient capital to enable them to do so without carrying an insufferable burden of debt.

An important and possibly a controlling financial reason for ownership is the calculated profit in the enhanced value of the lands. As has been shown, this is an important consideration to the large landowner who rents his land for a comparatively small return in yearly income and who receives a satisfactory return in the advance in values of farm property. In Table VI, for instance, the average farm income on owner farms valued at $4,709 to $13,665 is only $850, compared with the farm income of $1,157 by the tenant operating on a capital of $2,015 to $3,237. If we take the average of say $8,000 for the value of the farm in the first class and calculate the enhanced value on that at the rate of 6 per cent per annum, as is warranted in the previous exhibit of advance in value of farm property over a period of 30 years, the result will add $480 to the $850, or a gross income of $1,330 for the farm owner, compared with an income of $1,157 for the tenant. Undoubtedly the expectation of increased value in the farm, based upon the experience of preceding years, is an additional reason, besides those already recited, for ownership, in spite of apparent loss of income on the year's operation.

In the one case he spends his income and makes no provision for his children or for his own old age. In the other he has laid by his income in a farm that insures a comfortable living when he is too old to work and provides a start in life for his offspring. It is decidedly

the exceptional man who finds it more advantageous to remain a tenant after he is able to become the owner of a good farm, and it is fortunate for the Nation that this is so.

There is another reason why, from the standpoint of national economy, tenant farming as a general proposition is not desirable. On the farms included in this study, the records show that notwithstanding the larger profit of the tenant with small capital, compared with the profit of the small owner, the records show also, as has been recorded, that the owner farms have less cotton and more feed crops, and consequently the agriculture under ownership is better balanced and more stable. The records show also that the owner farms produce a larger yield per acre. It is seen that ownership induces better cultivation, maintains soil fertility, and increases substantial values. The lesson to be drawn from the study in this respect is that while it is unwise to purchase high-priced land upon small payment at a high rate of interest, ownership is to be encouraged when there is a reasonable expectation of accomplishment.

HIRED AND CROPPER LABOR.

Owners have two alternatives with respect to labor: They may hire labor by the day, month, or contract, or they may employ cropper labor. Table VIII shows the relation of the croppers to the owners or operators on farms of different sizes. On farms having 80 acres or less of crops, averaging 62.5 acres per farm, 9.2 per cent of the land is worked by cropper labor. As the farms increase in size, more cropper labor is employed until in the group of farms of 121 acres or more 22.5 per cent of all land is worked by cropper labor. The average amount of land worked by croppers in the region is 18 per cent of the total crop area. The acreage of cotton produced by cropper labor, however, is 22 per cent of the total. The fact that there is a considerable increase in amount of land worked by croppers as size of farm increases is accounted for by the fact that the operator is not able to give proper oversight to the larger acreage where wage or hired labor is employed; further, the responsibility of securing extra labor for chopping and picking is transferred to the croppers.

TABLE VIII.—*Relation of size of farm to percentage of acreage farmed by wage and cropper labor (114 farms, Ellis County, Tex., in 1914).*

Size of crop area.	Number of farms.	Average size crop area.	Per cent of total crop area worked by wage labor.	Per cent of total crop area worked by cropper labor.
80 acres or less	37	62.5	90.8	9.2
81 to 120 acres	39	100.1	85.2	14.8
121 acres and more	38	198.9	77.5	22.5
All farms	114	117.5	82.0	18.0

The cropper, or "half hand" as he is often called locally, is a laborer rather than a tenant. He is furnished with a house and small garden patch; often he is permitted to keep a cow or horse for his own use. A definite acreage is set aside by the operator on which the cropper grows the crops, furnishing all the man labor for this acreage. The operator furnishes all power and machinery for the cultivation. When the crops are gathered, the operator and cropper share equally in the division, each paying for his share of the ginning.

The value of the cropper's labor, together with the cost of ginning his share of cotton, averages $9.56 per acre at current wage rates. His share of the crops, which is what he receives for his labor,

FIG. 4.—Type of tenant farmstead, Ellis County, Tex.

amounts to $15.34 per acre, which leaves a profit to the cropper of $5.78 per acre.

TABLE IX.—*Distribution of cropper expenses and receipts, and net income (40 croppers, 24 farms, Ellis County, Tex.).*

Number of farms	24
Number of croppers	40
Acres per cropper	59
Number of days miscellaneous productive labor per cropper	28
Cropper's receipts from crops	$860
Cropper's receipts from miscellaneous labor	42
Cropper's total receipts	902

Value of family labor per cropper	$179
Cost of hired labor per cropper	73
Interest on cash to operate per cropper	13
Ginning cost per cropper	84
Total expenses per cropper	349
Net income per cropper	553
Estimated value of cropper's own labor	228
Profit to cropper over value of his labor	325

Table IX shows the distribution and summary of the cropper's expenses and receipts. The difference between cropper's receipts and expenses amounts to $553, which he receives for his labor. Deducting the average estimated value of the cropper's labor at current wage rates his profit is $325. He receives this amount partly to

FIG. 5.—Farm residence of a large land owner.

cover risk on his share of the crop, and partly because he requires less supervision than the hired laborer.

In figure 4 is shown a farmstead typical of rented farms in Ellis County. Figure 5 shows a representative owner's residence.

CONVERTED TENURES.

In order to have a sufficient number of farms in each of several groups to determine the effect of various factors on farm practice, efficiency, etc., it was necessary to eliminate the factor of tenure after the foregoing tables had been compiled. This was accomplished by eliminating all transactions between landlord and tenant. All farms not operated by their owners were converted to the basis of working owners by charging the tenants with the value of the

land rented. All expenses were charged and receipts were credited to the operators as though they owned the land. All calculations hereafter mentioned in this bulletin treat of the farms as though operated by their owners, thus eliminating the factor of tenure. By this method, labor incomes, per cent return on investment, and other standards of efficiency, are made comparable for all farms.

TYPE OF FARM.

Stock holds a very minor place in the farm practice of Ellis County. Only 9 per cent of the farm area is devoted to pasture, 87 per cent being in crops, and the remaining 4 per cent waste land occupied by roads, stream channels, bluffs, etc. Fifty per cent of the farms have more than 90 per cent of the farm area in crops and 90 per cent have more than 70 per cent of the farm area in crops. Twenty-one per cent of the farms have no pasture land and 73 per cent have less than 10 per cent of their area in pasture. Crop farming, therefore, is the major portion of the farm business.

FIG. 6.—Proportion of crop land devoted to the principal crops (115 farms, Ellis County, Tex.).

Figure 6 shows graphically the proportion of the crop land in the principal crops. It is seen that cotton occupies 71.9 per cent, or nearly three-fourths of the crop area, corn 14.1 per cent, oats 6.9 per cent, alfalfa 1.9 per cent, wheat 0.6 per cent, and miscellaneous crops 2.7 per cent. The miscellaneous crops consist of the following: sorghum, milo maize, kafir corn, Sudan grass, Johnson grass, sweet potatoes, and a few others of very minor importance.

Sixty-seven per cent of the farms have more than 70 per cent of their crop area in cotton, while only 4 per cent have 40 per cent or less of their crop area in cotton. Five per cent of the farms have no corn. Fifty-eight per cent have from 11 to 20 per cent of their crop area in corn, and only 1 per cent have more than 30 per cent of their crop area in corn.

Eighty per cent of the farms have no oats for grain and 36 per cent have no oat hay. Thirty-one per cent have no sorghum, and 99 per cent have less than 10 per cent crop acreage in this feed crop.

Ninety-one per cent of the farms have no wheat and 93 per cent have no alfalfa.

The case is somewhat similar with feed stuffs. Cotton growers too often depend on buying them, when they could produce them on the farm with little extra expense. Even where cotton is the only farm product that can be relied on as a source of income, it is undoubtedly good practice to produce the food and feed required on the farm as largely as possible, and the best farmers do so.

Because of the time required to obtain from the farmer the details necessary to an analysis of the farm business, it is not practicable at the same time to get a financial account of what the farm furnishes toward the family living. The latter is a separate study. No such study has been made in Ellis County, though one has been made in McLennon County, where conditions are somewhat similar. In this region, as in all regions devoted to a one-sided system of farming, farmers often neglect the opportunity they have to produce an abundance and variety of food. As a result the family lives largely on materials bought at the stores. This is one of the evils of a one-crop system. Even if it were true, as many cotton farmers claim, that they can raise cotton and sell it and buy fruits, vegetables, and poultry and dairy products cheaper than they could raise them, the fact remains that unless they are produced on the farm the family will not have them in abundance, and what they do buy is not of as high quality as that produced at home.

TABLE X.—*Percentage of total receipts from different sources in 1914. (115 farms, Ellis County, Tex.)*

	Per cent.
Cotton	86
Corn	2
Other crops	3.4
Stock	5.6
Increase feed and supplies	1.3
Miscellaneous	1.6

Table X shows the sources from which the income is derived. With 86 per cent of the receipts from cotton, it is clear that cotton is the all-important enterprise of every farm.

Alfalfa was found on 8 of the farms studied. The yield of cotton per acre on these farms was greater than on farms where no alfalfa was produced. Indications seem to point to the future production of larger areas of alfalfa, not to displace cotton, but to increase the yield of cotton and also the net returns of the farms. There is no doubt that the production of alfalfa will greatly improve the fertility of the soil. It is unfortunate that there are not more farms in the alfalfa groups in order that more definite conclusions might be drawn.

SIZE OF BUSINESS.

In the tabulations which follow it is shown quite conclusively that the farm income increases as the size of the farm business increases. But it should not be inferred from this that all farms should be large farms. Many men who succeed fairly well on small or moderate-sized farms would fail utterly on farms so large as to require a great deal of hired labor. Many men who can themselves work efficiently can not direct efficiently the work of others. One reason why large farms are generally more profitable than small ones is that the men who run them are men of large ability. When a man of small business capacity undertakes to manage a large farm he loses money for the owner.

In general, it is desirable that every farmer have as large a farm as he can manage efficiently.[1]

In practically all the tabulations relating to size of business, records from 115 farms are used, being divided according to size into three groups of 36, 40, and 39 farms, respectively. However, in some tabulations where costs were involved only 114 farms are used.

RELATION OF SIZE OF BUSINESS TO DISTRIBUTION OF INVESTMENT.

There is scarcely any difference in the price of land per acre between the small and the large farms. However, there is a slight decrease in the amount of working capital per acre utilized in the larger farms. On farms of approximately 60 acres of crops the working capital (work stock, equipment, cash required to run the farm, etc.) amounts to about $20 per acre, while on farms of approximately 200 acres of crops the working capital amounts to less than $14 per acre. This is due to the more efficient utilization of the stock and equipment on the larger farms.

The value of buildings per acre is also slightly less on large farms than on those of smaller area, although the value of buildings per farm is greater on the larger farms. The average value of dwellings

[1] "The minimum efficient unit" in agriculture is a farm of sufficient size and so organized as to give full employment at productive labor to the farm family. The farm may be any amount larger than this, provided the operator has sufficient ability to make the larger business efficient, but there are very distinct disadvantages if the farm business is smaller than the most efficient unit as above described. When such is the case, the farm family does not have the opportunity to exert its full earning power.

The fact that the minimum efficient unit in farming is relatively very small as compared with most other industries is the most attractive feature of farming as a business. Because of the small size of this unit economic independence is fairly easy of accomplishment and many prefer independence with a moderate competence to independence with a very small chance of pronounced success.

The ideal size of farm is somewhat larger than the minimum efficient unit. It is such as to permit a high standard of living and the education of the farm children, but the ordinary family farm with good management will often permit this.—W. J. Spillman, in U. S. Dept. Agr. Bul. 341, p. 54.

on the farms studied is approximately $1,200; the average value of all other buildings, consisting of tenant houses, barns, sheds, etc., is about $550 per farm.

The number and value of work stock increases when the size of farm increases, but not in the same proportion. Farms of 60 acres average slightly more than 3 head of work stock, and farms of 200 acres utilize an average of nearly 8 head per farm. The average value of work animals on all farms is $135 per head (1914).

The average value of cattle is $141 per farm. Other productive stock, consisting of about 75 chickens, 3 to 5 hogs, turkeys, ducks, guinea hens, etc., are valued at approximately $100 per farm.

RELATION OF SIZE OF FARM TO TYPE AND YIELD PER ACRE.

The proportionate acreage of cotton increases slightly as the size of farms becomes larger and a slightly less proportionate area of corn is produced on the larger farms. The other miscellaneous crops show no regularity of increase or decrease as size of farm increases.

Size of farm has a slight effect on the yield of cotton. Thirty-six farms of 80 acres or less, averaging 62.5 acres, make an average yield of cotton of 256 pounds of lint per acre. Forty farms from 81 to 120 acres in size make an average yield of 247 pounds of lint per acre. Thirty-nine farms of more than 121 acres, averaging 188.9 acres, make an average yield of 233 pounds of lint per acre. The average yield of cotton for all farms in the survey is 241 pounds of lint.

Size of farm apparently has no effect on the yield of other crops. The average yield for all corn is 25.6 bushels per acre; for sorghum, 2.8 tons; and for alfalfa, 2.51 tons.

EFFICIENCY OF HORSE LABOR.

Table XI shows the relation of size of farm to the efficiency of horse labor. As the size of farm increases, the number of days of productive labor that each animal performs annually increases, those on the small farms accomplishing 60.3 days of productive work while on the large farms each animal works 79.1 days. The figures in the column headed "Acres per horse" are obtained by dividing the number of crop acres by the number of work animals per farm. It is seen that the work stock accomplish considerably more work on the large farms than on the small ones. At the same time there is very little difference in the amount of labor performed on each acre, as indicated in the column showing "Horse days per acre."

TABLE XI.—*Relation of size of farm to efficiency of horse labor (114 farms, Ellis County, Tex.).*

Size of crop area.	Number of farms.	Average size of crop area.	Horse days per horse.	Acres per horse.	Horse days per acre.	Cost of horse labor per crop acre.	Cost of work stock, per day of labor.
80 acres or less	37	62.5	60.3	18.5	3.25	$5.47	$1.68
81 to 120 acres	39	100.1	66.7	20.6	3.22	4.95	1.54
121 acres and more	38	188.9	79.1	25.2	3.14	3.99	1.27
All farms	114	117.5	71.7	22.4	3.19	4.53	1.42

One of the many weaknesses of the one-crop cotton system of farming is shown by the facts brought out in the preceding paragraph. Even on the large farms, where horses are used most efficiently, the average horse works less than 80 days during the year. This adds greatly to the cost of a day's work for a horse. The same difficulty exists to a considerable extent with man labor on cotton farms. There is too much work at certain seasons and not enough at others. It is only when cotton is relatively high priced that such disadvantages are overcome. Unfortunately, in the past there have been many periods when prices fell below cost of production, and this caused great suffering.

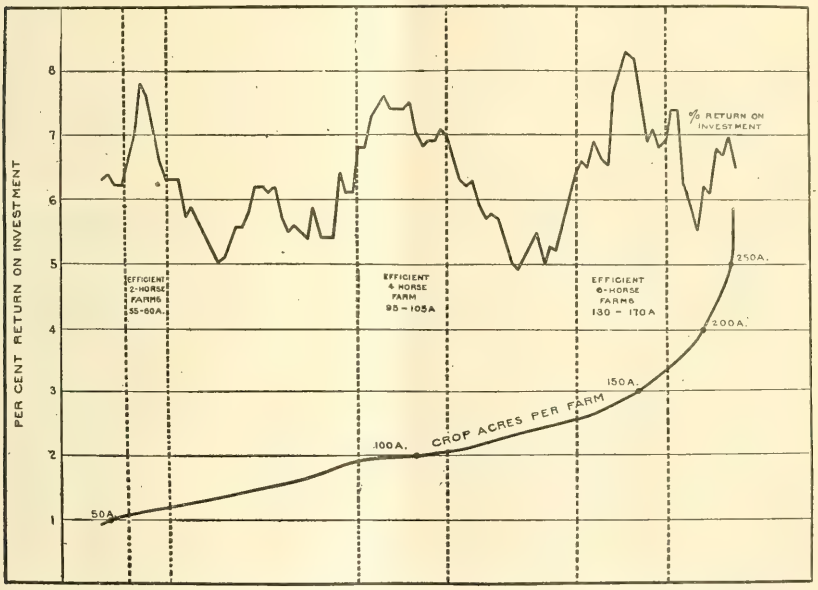

FIG. 7.—Relation of size of farm to percentage return on investment, showing sizes favorable for most efficient use of two horses, four horses, and six horses.

The graphic illustration (fig. 7) shows certain relationships between size of farms and returns. It is seen that as the curve repre-

senting size of farm (crop area) rises from left to right, there are three noticeable high points in the curve representing the per cent return on investment for the corresponding groups of farms as represented by the size curve. These high points are caused primarily by the efficient use of teams. It is seen that the first high point of the curve representing per cent return on investment occurs for farms from 55 to 60 acres in extent; the second high point occurs for farms of from 95 to 105 acres and the third high point occurs for farms from 130 to 170 acres.[1]

TABLE XII.—*Appropriate number of teams for farms of different sizes, Ellis County, Tex.*

Crop area.	Number of horses per farm.	Number of records.	Average crop area.	Horse days per horse.	Acres per horse.	Per cent return on investment.
39 to 75 acres	2	11	56	89	29	6.5
	4	13	61	51	16	4.9
75 to 140 acres	4	19	98	72	24	7.1
	6	15	110	60	18	5.1
140 acres and over	4	2	142	131	36	9.2
	6	5	188	83	23	5.9

In Table XII is shown the appropriate number of teams for farms of different sizes as indicated by the curves of figure 11. The first two groups, consisting of 11 and 13 farms, respectively, are composed of the two-horse and four-horse farms from 39 to 75 acres in extent. It is seen that the two-horse farms make much better use of the work stock than do the four-horse farms; the two-horse farms average 56 acres, while the four-horse farms average only 61 acres. It is apparent therefore that farms of 61 acres are not large enough for efficient use of four animals, since on the two-horse farms the equivalent of 29 acres is covered by each animal. The returns of the two-horse farms are 6.5 per cent, while the income of the four-horse farms is only 4.9 per cent on the investment.

The first high point of the curve (fig. 7) representing per cent return on investment is reached when the efficient size for two horses is reached. Beyond this point the farms are too large for efficient use of two horses and not large enough for four animals until farms of about 100 acres are approached. Farms of less than about 50 acres do not make efficient use of horse labor and consequently make low returns, as indicated by the curve.

The same relationships are found between the four-horse and six-horse farms of from 75 to 140 acres in extent as were seen for two-

[1] The curves were constructed by the use of the moving average. The farms were arranged in the order of size from smallest to largest and each point of the curves represents the average of 11 farms, 5 farms on each side of the point being averaged with the farm of that size.

horse and four-horse farms of smaller size above. Four-horse farms averaging 98 acres make good utilization of horse labor and better returns than six-horse farms of the same size group averaging 110 acres (Table XII). It therefore appears that the second high point of the curve (fig. 7) is reached on farms of from 95 to 105 acres where four work animals are utilized. Farms of less acreage are not large enough to utilize four animals efficiently and farms larger than 105 acres are too large, but not large enough for six animals until 130 acres is reached.

Similar conclusions are justified for the third high group (fig. 7), although the size of farms increases so rapidly and not enough farms are included to locate so definitely the exact efficient size of six-horse farms. It appears that six animals should operate not less than 130 acres and not more than 170 acres, the most efficient acreage being doubtless between 140 and 155 acres.

TABLE XIII.—*Relation of size of farm to distribution and summary of receipts, expenses, and income (115 farms, Ellis County, Tex.).*

	All farms.	80 acres or less.	81 to 120 acres.	121 acres or more.
Number of farms	115	36	40	39
Average crop acres per farm	117.55	62.5	100.1	188.9
Crop receipts	$2,755	$1,467	$2,451	$4,256
Increase feed and supplies	49	27	35	85
Stock receipts	118	98	119	137
Miscellaneous	43	40	38	51
Total receipts	2,955	1,632	2,643	4,529
Current expenses	1,170	586	983	1,901
Decrease feed and supplies	47	42	41	58
Stock decrease	7	2	6	14
Depreciation, buildings and machinery	100	74	95	130
Total expenses	1,324	704	1,125	2,103
Farm income	1,641	928	1,518	2,426
Rent and interest on working capital	679	374	643	993
Income above rent	962	554	875	1,433
Per cent return on investment	6.3	6.0	6.4	6.4

RELATION OF SIZE OF FARM TO RECEIPTS AND EXPENSES.

As the size of farm increases, both receipts and expenses increase. The farm income, which is the difference between receipts and expenses, also increases. Table XIII shows the relation of size of farm to various items of expense and receipts, farm income, etc. When the estimated average value of the farmer's labor is deducted from the farm income and the result is divided by the amount of the investment, it is seen that the average return on the investment for all farms is 6.3 per cent, with very little variation with the size of farm. Since the income above rent shows certain regularity with the size of

farm, this factor is used as a measure of efficiency in other tabulations when size of farm does not enter as a disturbing factor.

Figure 8 shows graphically the relation of size of farm to income above rent and percentage returns on the investment. The series of vertical lines (bottom of figure) represents the size of farm in crop acres, each line representing one farm arranged from left to right according to size. The horizontal line at 117.5 acres represents the average crop area per farm for all of the farms studied in the survey.

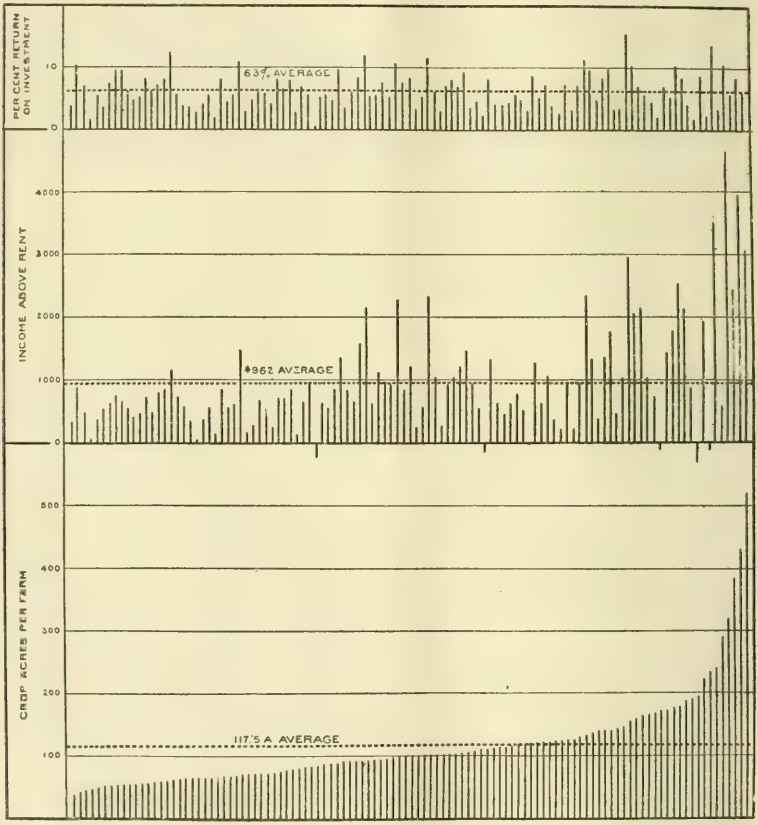

FIG. 8.—Relation of size of farm (bottom) to income above rent (middle) and to present return on investment (top) (115 farms, Ellis County, Tex.).

The series of vertical lines in the middle of the figure represents the income of the same farms shown at the bottom of the figure; the horizontal line (middle) represents the average income above rent for all farms. It is seen that as the size of farm increases (left to right) the incomes become larger, i. e., more of them are above the average line than among the farms of smaller size. Also, it is observed that there are more incomes that fall below the zero line as

the farms become larger. This indicates that as the size of farm increases the opportunities for increased income are greater, and also that the chances for loss increase. In other words, as the size of farm increases, the chances for both large and small incomes increase with the risk, showing greater average returns, however, on the larger farms.

The vertical lines at the top of figure 8 represent the percentage returns on the investment for the same farms, respectively, as represented at the bottom of the figure. The horizontal line (top) represents the average of the percentage returns for all farms, being 6.3 per cent on the investment. It is seen that there are practically as many farms making small percentage returns on large farms as on small ones.

The following conclusions seem justified by the foregoing data concerning size of farm among those studied:

There is better utilization of capital on the large farms than on the small ones. Each dollar of working capital (stock, equipment, etc.) accomplishes more work on the large than on the small farms.

The management is more economical, although possibly not quite as efficient, on the large farms as on the farms of less acreage.

The most efficient size for two-horse farms here appears to be from 55 to 60 acres of crops; for four-horse farms from 95 to 105 acres, and for six-horse farms from 140 to 155 acres.

There is a slightly greater percentage return on the large farms than on the small ones, due to better utilization of labor and lower unit cost of operation.

The total net receipts are greater on the large farms than on the small ones.

The small farms show a greater yield of cotton per acre than the large farms.

Farmers of this region have not generally made the mistake of operating too small an area for the efficient utilization of capital and labor; the smallest farm studied consists of 39 acres of crop land, and the largest 522 acres.

QUALITY OF FARMING.

The curve shown in figure 9 gives the range of yield of cotton per acre from year to year. The yield for 1903 and 1904 was approximately one-half bale per acre, but for five or six years thereafter the yield per acre alternated from high to low, varying from more than 300 pounds of lint per acre in 1906 to 125 pounds of lint in 1909. Again in 1912 the yield of lint was nearly 300 pounds. The straight line across the figure shows approximately the average tendency of

yields from 1903 to 1914. It is seen that this line has a marked downward tendency, indicating that the average yield per acre has gradually decreased during this period.

The variations from year to year in the yield per acre are accounted for by climatic or other conditions, over which the farmers have little control. However, the average downward tendency of the yield per acre is a matter of vital concern to the farmers, and also is a matter over which the farmers can have some influence. It appears certain that the system of farming followed here at present is not self-sustaining. Eventually farmers must either change to some other system, or must so change their practices with the present one as to rebuild the soil.

The forces that determine what system of farming is best in a given locality are so complex that no human agency can tell what system is best until the matter is worked out in practice. In Brooks County, Ga., where the single crop cotton system held sway until yields were reduced to a point that made a change necessary, hogs and peanuts became the farmer's main dependence. But peanuts are not so well adapted to the soils of Ellis County, Tex., and raising hogs for market, as distinguished from raising the home supply, requires careful management on soils that become very muddy in wet weather. It is unwise to try to suggest new systems of farming for this region until a careful study has been made of the system prevailing in other similar regions where this problem has been worked out, if such regions can be found. Such a study is contemplated.

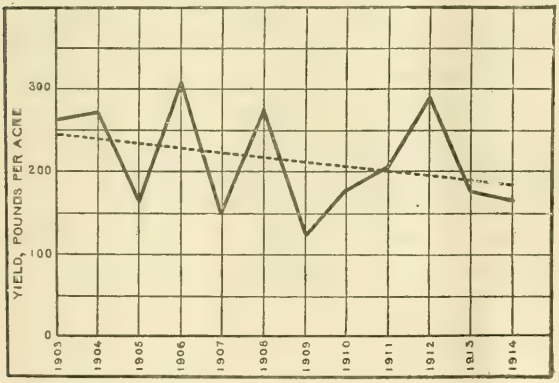

FIG. 9.—Variation in yield per acre of cotton from 1903 to 1914. Ellis County, Tex. (Data furnished by U. S. Bureau of Crop Estimates.)

The experience of farmers in Marlboro County, S. C., seems to offer a suggestion. That county long since reached the point where continuous cotton culture with no attention to soil fertility made a change necessary. To-day it has soil of wonderful yielding power. Its yield per acre of cotton is remarkably high. In this locality it was long ago learned that the application of commercial fertilizers would greatly stimulate the growth of cotton. The use of a little manure or vegetable refuse of almost any kind aided materially. It

is well known that soil, in order to be fertile, must contain a considerable quantity of decaying vegetable matter (humus). The farmers of Marlboro County have learned that after they have forced the yield of cotton to a bale per acre, the stalks and leaves of the cotton plant, if carefully returned to the soil, will keep it sufficiently supplied with vegetable matter. When the yield is less than a bale it is necessary to use more vegetable matter than this.

The sandy loam soils of Marlboro County, S. C., are quite different in character from the "black-waxy" soils of Ellis County, Tex., and doubtless require different treatment. From what is known of the black-waxy soils, it is probable that nitrogen is the only commercial fertilizer that would do much good on them. Heretofore the cheapest source of commercial nitrogen has been nitrate of soda. But this is now very expensive. Fortunately, the farmer is in position to produce his own nitrogen. This he can do by growing legumes, either for forage or as green manures. There are several legumes that can be sown in cotton fields late in the season and plowed under in the spring. Bur clover, crimson clover, and hairy vetch are examples. It is not known how these crops would behave on the black-waxy soils of Texas. It is believed, however, that they are worthy of trial on a small scale as above suggested. Any of them that will grow 4 inches high in time to turn under in the spring will add enough nitrogen to the soil to stimulate the growth of cotton very materially.

Another method of getting nitrogen and vegetable matter into the soil practiced extensively on a Georgia farm is as follows: Hairy vetch is sown between the cotton rows at the last cultivation. No further attention is paid to it until the time to plant cotton in the spring. A middle-buster is then run in the middles between the rows of old cotton stalks which are still standing. The dirt is then thrown back to the middles and the new crop of cotton is planted. It is cultivated sufficiently to keep the land clean near the new rows until the vetch, which is still growing on the old stalks, has matured to seed, the seed being allowed to fall to the ground for a new seeding. The old rows are then run over with a stalk cutter, and these and the vetch vines and seed are cultivated into the soil. The vetch seed comes up about the time the new crop of cotton is laid by, and the same process is repeated from year to year.

After the yield of cotton has been brought up to a bale or more per acre, it is probable that plowing under the cotton stalks and leaves will keep the Ellis County soils sufficiently supplied with vegetable matter to maintain good yields, especially if a little nitrate of soda is used, and careful use is made of such manure and waste vegetable matter as can be found about the farm.

The records show that on those farms which grow some alfalfa the cotton yields are higher than on others; but this can hardly be due

to the presence of the alfalfa, for a field of cotton following alfalfa is rarely found. There is no question that alfalfa would increase the yield of cotton for several years after an alfalfa sod is plowed up. At present alfalfa on these Ellis County farms is largely confined to small areas on exceptionally good land. Whether it would be generally profitable to the farmers of this region is not known, but the presumption is in its favor. It is certainly a crop that would be highly useful as a source of feed for the farm animals, and that would greatly increase the fertility of the soil. It should be tried more generally, but yet conservatively. It would hardly be wise to sow a large acreage of it until the farmer has learned with certainty how to grow it, and how it will fit into his system of farming. A small acreage of alfalfa is desirable on almost any farm where it will grow readily. To handle a large acreage of alfalfa successfully requires considerable experience, and is not desirable unless there is either a good market for the hay or plenty of live stock on the farm to consume it.

In sowing any legume new to a locality it is usually advisable to inoculate either the seed or the soil with the particular kind of bacteria that crop requires. Inoculating material for this purpose, with directions for its use, may be obtained from the United States Department of Agriculture. After the crop is once successfully grown, soil from where it grew can be used to inoculate the soil of other parts of the farm. Many farmers have failed with legumes because they neglected this matter of inoculation. Failure is certain unless the soil is already inoculated.

It is essential to the continuation of cotton farming in Ellis County, as well as in other parts of Texas, that the yield be maintained at a point as high as or higher than at present. Table XIV shows the relation of yield of cotton to income. The 115 farms are grouped according to yield per acre of cotton with 31, 33, 25, and 26 farms in the respective groups. The average yield per acre of these groups varies from 184 pounds of lint in the first to 323 pounds in the last.

TABLE XIV.—*Relation of yield of cotton per acre to income per farm (115 farms, Ellis County, Tex.).*

Yield of lint per acre.	Number of farms.	Average yield per acre.	Crop acres per farm.	Income above rent per farm.	Per cent return on investment.
		Pounds.			
136 to 208 pounds	31	184	120	$600	4.9
209 to 240 pounds	33	225	133	846	5.6
241 to 277 pounds	25	260	127	1,155	6.5
278 to 402 pounds	26	323	99	1,366	8.6
All farms	115	[a] 245	118	962	6.3

[a] Unweighted average.

This observation revives the question of ownership, to which allusion has already been made. It is not to the interest of the tenant to plant alfalfa even if he were encouraged to do so, because the profit of that crop from the first year's planting is comparatively small; it is valuable from the standpoint of yield because one planting suffices for several years. Under present customs the rental contract is usually for only one year. Without some change in the tenure system there will be further depletion of soil fertility. The contrary result is encouraged by ownership, for the owner has every reason for maintaining and increasing the fertility of the soil and the yield of his acres.

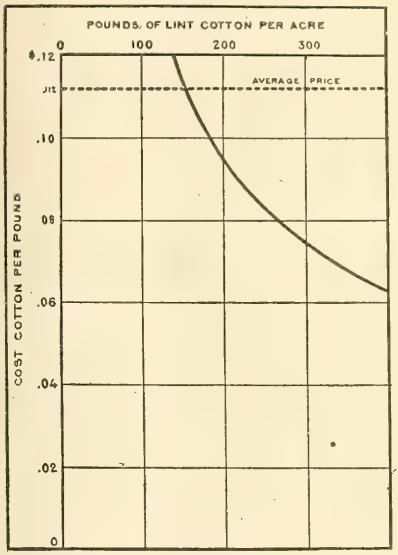

FIG. 10.—Relation of yield to cost of production of lint cotton (115 farms, Ellis County, Tex.).

That the yield has a direct relation to income is shown by the percentage return on investment and by income above rent. Farms making an average yield of 184 pounds make a return of 4.9 per cent on the investment. The same farms make incomes above rent of $600. Each of these expressions of income increases as the yield per acre increases and almost directly in proportion to the amount of increase of yield.

The curve shown in figure 10 illustrates graphically the relation of yield to cost. It is seen that where the yield is as low as 155 pounds per acre, the cost of production is equal to the value of the cotton (11.2 cents per pound). As the yield increases the curve drops rapidly, so that when a yield of 400 pounds per acre is made the cost is slightly over 6 cents per pound.

TABLE XV.—*Relation of yield to cost of cotton (139 crops, 114 farms, Ellis County, Tex.).*

	Yield of lint per acre.				Average.
	200 pounds or less.	201 to 250 pounds.	251 to 300 pounds.	301 pounds and over.	
Number of crops	27	52	42	18	.....
Yield per acre (pounds lint)	170.3	226.7	274.7	344.6	245
Number man days per acre	4.82	5.44	6.00	6.79	5.65
Number horse days per acre	3.12	3.10	3.23	3.34	3.17
Rent per acre	$4.72	$4.90	$5.38	$5.80	$5.13
Man labor cost per acre	$8.75	$9.52	$11.74	$12.80	$10.46
Horse abor cost per acre	$4.62	$4.79	$4.90	$4.79	$4.79
Ginning cost per acre	$1.07	1.41	$1.72	$2.13	$1.49
Cost of lint per acre	$17.97	$19.47	$22.51	$23.97	$20.68
Value oi lint per acre	$19.07	$25.36	$30.76	$38.60	$27.44
Cost of lint per pound (cents)	10.5	8.6	8.2	6.7	[a] 8.7

[a] Unweighted average.

Table XV shows the distribution of costs on cotton when different yields per acre are obtained. The cost of each crop of cotton on the 114 farms was computed separately, so that the averages are for crops and not for farms. The average number of days of man labor per acre increases with the yield, due to the increased amount of labor required for picking. However, the increase in yield from 170.3 pounds to 344.6 pounds is 102 per cent, while the increase of man labor is only 41 per cent. The average amount of horse labor required per acre for the crops making the lowest yields is 3.12 days, while on the crops making the highest yields the number of horse days required is 3.34. This is an increase of only 7 per cent. This table further shows that the rent per acre increases as the yield increases. The rent of crop land making yields of 170.3 pounds is $4.72, while that of the land making a yield of 344.6 pounds of lint is $5.80.

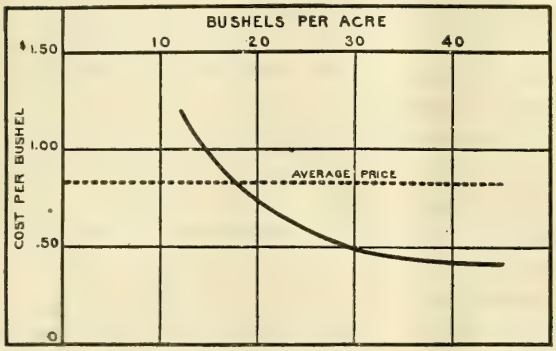

FIG. 11.—Relation of yield to cost of production of corn (115 farms, Ellis County, Tex.).

There is an increase in man labor cost per acre from $8.75 on the crops making low yields to $12.80 on crops of high yields, being an increase of 46 per cent. There is a slightly greater increase than in the number of man days required per acre on the same farms. There is scarcely any increase in cost of horse labor as the yield per acre increases.

The ginning cost, being a charge based directly on the quantity of cotton, increases directly with the yield.

The total cost of lint per acre increases 33 per cent, while the increase in value is 102 per cent. The yield per acre increases more rapidly than the cost per acre, so that as the yield increases from 170 pounds to 344.6 pounds the cost per pound decreases from 10.5 cents to 6.7 cents.

The same results were found for corn as for cotton, with only very slight variations. Figure 11 and Table XVI show the relation between yield per acre and the cost per bushel. When corn yields less than 18 bushels per acre, the cost is greater than the market value. The average yield of corn for the region was 25.6 bushels per acre at an average cost of 58.4 cents per bushel. As the yield increases beyond the average the cost continues to decrease, but not as rapidly.

The data from these farms indicate that the point has not yet been reached where the cost increases with the yield (law of diminishing return), but the curve would seem to indicate that this point for this region, and with methods now used, is not far above 50 bushels per acre.

TABLE XVI.—*Relation of yield to cost of corn (119 crops, 114 farms, Ellis County, Tex.).*

Yield per acre.	Number of records.	Average yield per acre.	Cost per bushel.
		Bushels.	
20 bushels or less	37	15.8	$0.94
21 to 30 bushels	62	27.5	.53
31 bushels or more	20	37.4	.45
All crops	119	25.6	.58

From these data concerning yields of the two principal crops, cotton and corn, it is apparent that considerable attention should be given to the matter of maintaining and even increasing the yields per acre. These relations may be expected to be affected by the use of manure, rotten straw, corn and cotton stalks, etc. In this section little effort is made to utilize these common fertilizers, manure being dumped in roads, stream channels, etc., while straw rots in the stack or is burned to make room for the planting of more cotton. The stalks of cotton and corn are frequently raked and burned, although the introduction of various types of stalk cutters (see figs. 17 and 18) makes it possible to get these humus-forming products into the soil again. Fortunately, the value of these various materials is becoming better known and more attention is being given to their utilization.

The size of the enterprise has some bearing on the yield of cotton. This is true on small farms as well as on the larger ones. A tabulation made on the basis of the proportion of crop land in cotton on each farm shows that where less than 60 per cent of the crop area is in cotton, average yields of 272 pounds of lint per acre are made. As the proportion of land in cotton increases to 86.2 per cent, the yield decreases to 230 pounds of lint per acre. On the farms where considerable areas of crops other than cotton are grown there is some change of crop on the same field from year to year. This of itself tends to increase yields.

Several varieties of cotton were found on the farms studied. One variety, known as Mebane's Triumph (see fig. 12), was predominant, 96 of the 115 farms producing this cotton. On 11 farms a number of varieties were found, among them being Rowden and Webb. On 9 farms the variety reported was "just cotton." Tabulations of yields of different varieties do not show material differences

in yield, and these averages are not reliable, on account of the small number of farms producing other than Mebane's Triumph.

The better farmers of the section follow a fairly uniform practice as to method of obtaining cotton seed for planting. They hold the opinion that cotton will "run out" or mix varieties in three or four years. To overcome this difficulty many buy pure seed every two or three years direct from the breeders of the respective varieties or from other sources furnishing pure seed. These farmers secure from 10 to 30 bushels each at a cost of from $1.50 to $2.50 per bushel. The second or heaviest picking of the cotton produced from this seed is ginned separately and the seed saved for the larger part

FIG. 12.—Mebane Triumph Cotton, the variety grown most extensively in the region. Big bolls, easily picked.

of the planting of the following year. If the second year's crop remains fairly true to variety, sufficient seed may be saved for a third year's planting.

VARIETIES OF CORN.

Records of varieties of corn were obtained from 78 farms. Thirty-seven farms produce some strain of yellow dent, 12 produce Bloody Butcher, and 10 produce Strawberry corn. On 19 farms "mixed" corn was reported. It is indicated that Strawberry corn gives slightly the best yields (29 bushels), but there is not a sufficient number of farms having the different varieties to determine reliable averages on this point.

COVER CROPS.

Scarcely any attention has been given in the region to the utilization of winter cover crops, with the exception of oats and a very little wheat. The fact that cotton picking often extends well into the winter season accounts in part for this condition.

It has been clearly demonstrated in other sections that a rotation of crops, even where no legumes are used, increases yields. Where legumes are included very marked increases are noted. For example, McNair, in Arkansas, found that where cotton followed cotton the average yield on 50 farms was 168 pounds per acre; following corn the yield was 197 pounds; following corn with cowpeas between the rows the yield was 251 pounds; and where cotton followed cowpeas (cut for hay) the yield was 270 pounds per acre. At 10 cents per pound the increased yield of cotton due to the previous crop of cowpeas was $11.73 per acre.

It is a well-known fact that the use of any cover crop tends to hold plant food in the soil, preventing its washing and leaching away. The use of legumes, such as vetch, crimson clover, bur clover, and others, actually adds the element nitrogen to the soil by taking it from the air.

These legumes may be planted between the rows of cotton, as winter wheat is now frequently planted in the black-land region, as soon as the cotton is picked. In the case of early maturing cotton, with a warm fall, the legumes should make a sufficient growth by the time of spring plowing to be of immense value when turned under. It is believed to be advisable for farmers on these black lands to experiment with these winter legumes as a possible means of increasing the yield of cotton.

FARM ORGANIZATION.

It already has been shown that cotton holds the most important place in the farming of Ellis County. A few farms in the county are dairy farms or diversified farms, but only one dairy farm and one diversified farm were found in this survey, and these were eliminated, since no reliable conclusions could be drawn from single instances.

It is not always possible to ascertain whether these types of farming found on a few farms in a locality could be successfully followed on farms generally in the region, though it is frequently possible to say they would not be successful generally. A few cases will illustrate this point. In Anderson County, S. C., a single farm was found that was doing well with hogs. The owner kept several brood sows, raised two litters of pigs a year from each of them, and sold the pigs at weaning time to neighboring farmers who wanted them

to feed from table scraps and other waste materials. This farmer's business was successful *because his neighbors were not keeping brood sows.*

In a survey of 270 farms at Monett, Mo., four dairy farms were found. They made good incomes. Three of them did so by supplying milk for the city of Monett. They occupied this field completely. The other made butter, and was successful only because the farm family was a very exceptional one.

A 25-acre farm in South Carolina was devoted exclusively to hay growing. It was highly successful because the hay was sold at high prices to neighboring farms *that did not produce hay.* Such cases as these tend to make farm-management investigators conservative in recommending changes in farm practice. They feel safe in recommending a new system only where a considerable body of local experience has grown up with it. However, such investigators frequently recommend *experiments* in a new direction. This is very different from recommending a new system of farming.

There is no well-established system of rotation in the region. Cotton occupies so much of the land that extensive rotation is not possible without a marked change in the system of farming. It is generally the practice to plant corn on the better land of the farm, preferably on bottoms, if possible. Legumes are found on only a few farms. A few farmers appreciate the value of rotations, and these make some effort to have a grain crop appear on all crop land once in three years. It is desirable to plant cotton on land previously occupied by grain on account of the fact that the fungus disease known as "root-rot" is not so prevalent under this condition. This disease attacks cotton and legumes (taproot plants), but not grains.

A study of this character does not give much information as to the value of diversified farming in a region like Ellis County. It is a study of farm experience, and local experience with diversified farming is so meager here that no conclusions can be drawn from it. Other types of farming might be better for the region than the one prevailing, but this can not be determined definitely in advance of experience, or at least extensive experiment, with a new system.

This study does reveal much of value concerning the details of the prevailing system. Some of the lessons bearing on these details are given in what follows.

CROPS.

Cotton.—In order to arrive at some indication of the proportion of the crop area that should be in cotton to make the best returns with the system prevailing in this region, a tabulation was made using the percentage acreage in cotton as the basis. The results,

shown in Table XVII, would seem to indicate that the acreage of cotton which produces the greatest immediate returns is found at about 80 to 90 per cent of the total crop area.

TABLE XVII.—*Relation of percentage acreage in cotton to percentage returns (113 farms, Ellis County, Tex.).*

Acreage in cotton.	Number of farms.	Per cent of total acerage in cotton.	Crop area.	Diversity index.	Per cent return on investment.
			Acres.		
25 to 63 acres	22	50.9	105.3	1.97	5.8
63 to 72 acres	21	68.1	125.5	1.51	5.9
72 to 76 acres	26	73.9	107.1	1.44	6.1
76 to 82 acres	23	79.0	138.9	1.32	6.8
82 to 99 acres	21	87.5	114.6	1.19	6.9
All farms	113	71.9	117.5	1.47	6.3

It is to be borne in mind that this observation is merely a record of the farming operations under survey. It is not intended to be advice to increase the percentage of cotton acreage, because for reasons already indicated cotton raising in this area is depleting the soil and the apparent profit on the farms under review is at the expense of soil fertility, well-balanced agriculture, and a wholesome rural development. The records show that if these important considerations are to be ignored, if the soil is to be "mined," and if social and family welfare are to be despised, the immediate profit upon the year's operation in a period of good prices will be greater with a cotton acreage of 80 per cent to 90 per cent of the total area than with less acreage in cotton. The average for all the farms in the survey is 71.9 per cent.

Right here we have the crux of the difficulty with Ellis County farming. The system that gives the best immediate returns is one that is gradually wearing out the soil,[1] and that seems to be headed straight toward its own destruction. Unless some change in practice is made soon, the average yield of cotton will become so low that the system will be unprofitable. Fortunate the region where the most profitable type of farming is one that maintains the fertility of the soil.

There are other disadvantages of this most profitable system here. It utilizes only a small part of the horse power on the farm. The man power is idle or poorly employed much of the time. The profitableness of cotton leads to the neglect of other essential features of good farming. The small provision made for producing food for

[1] This term is somewhat misleading. The soil does not actually wear out; its yielding power is reduced. But by suitable methods this power can be restored. The most essential factor in such restoration is the incorporation into the soil of plenty of decaying vegetable matter.

home consumption leads to a low standard of living on the part of farm labor.

Tabulations concerning the amount of receipts derived from the sale of cotton brought out the following: Where sales of cotton amount to less than 80 per cent of the total receipts the income is below the average; where cotton sales amount to from 81 to 90 per cent of the total receipts, the income is considerably above the average; where the receipts from cotton sales are over 90 per cent of the total, the income is very slightly above the average.

Corn and minor crops.—Corn occupied on the average for all farms 14.1 per cent of the crop area. Tabulations were made to determine the most profitable acreage of this crop, and to ascertain whether the production of corn for sale added to the farm income. The general result appears to be that those farms producing slightly more corn than was needed for home consumption were most profitable. The greater profit is believed to be due not to the fact that corn was produced for sale, but because a small surplus for sale insures an abundance for home use.

Practically the same was true for such crops as oats, sorghum for hay, kafir, milo, etc.

Again, attention is called to the fact that these deductions are the records of farming as practiced. It is a question whether better cultivation of corn and other crops would not yield better returns. It is the uniform habit in the cotton region for the farmer to give his best attention to his cotton, which represents his principal cash income.

Alfalfa.—This crop was found on only eight farms in this study. These farms were for the most part located on low lands, and had somewhat better soil than the average. The value of this crop as a source of feed for the farm animals is unquestioned. While no positive statements can be made as to its desirability for the farms of this region generally, it is believed that every farmer in the region should endeavor to grow at least a small area of it. It is a legume and requires inoculation unless the alfalfa bacteria are already present in the soil.

Another reason for experimenting with this crop is that, in case the present local system of farming fails, alfalfa is itself a very good money crop, and in connection with other forage crops may be made the basis of an excellent system of live-stock farming.

Live stock.—Farm animals may be divided into two classes, namely, work stock and productive stock, the latter being those kept for their products, such as meat, milk, wool, eggs, etc. The work stock on these 115 farms averaged 5.25 head per farm. The acreage of crops per work animal has already been discussed in connection with size of farms.

The number of productive live stock per farm is the equivalent of 4.26 mature animals. They consist usually of a cow or two for the production of milk and butter, a few hogs for meat, and a moderate-sized flock of poultry for eggs and meat. These products are intended mainly for home use, with frequently a small surplus for sale.

The quantity of such products sold from these farms was so small that it had little influence on the farm profits one way or the other, but it is to be noted that those farms making most profit generally produced slightly more live-stock products than were needed for home consumption.

Local experience with live-stock enterprises is not sufficiently extensive to make it possible in a study of this character to determine the desirability of such enterprises. But the fact that very few farmers here keep much more productive stock than are needed for home use would lead the careful student to be conservative in recommending the general extension of such enterprises. It is a fact that many farmers in this region have tried various live-stock enterprises from time to time on a considerable scale. The fact that almost no such enterprises remain indicates that local farmers have not found them so well adapted to local conditions as cotton farming. This may be due in part to lack of knowledge of stock farming on the part of local farmers. If for any reason cotton farming should become unprofitable, or far less profitable than now, it is probable that some type or types of stock farming would be found to do very well here. At present about all that can be said with confidence is that every farm should certainly keep enough productive stock to supply its own needs for their products. It would appear that these farmers generally do this. Furthermore, the records show that they raise practically all the feed needed by their live stock, which is in keeping with sound practice.

The farm needs include especially milch cows, hogs, and poultry sufficient to supply the family, with a little surplus. Such live stock, by consuming waste, by affording diversity of interest, by furnishing fertilizer, by encouraging the raising of winter cover crops, and by making sure abundant wholesome food for the family, return a much greater profit than would appear from bookkeeping records.

TABLE XVIII.—*Average value of feed per farm and per animal unit*[a] *(115 farms, Ellis County, Tex.)*

Number of work stock per farm	5.25
Number of productive animal units per farm	4.26
Total animal units per farm	9.51
Value per farm:	
Feed raised	$578
Feed bought	91
Increase in inventory	—9
Feed sold	162
Feed consumed	516
Value of feed consumed per animal unit	55
Value of feed consumed per work animal	83
Value of feed consumed per productive animal unit	19

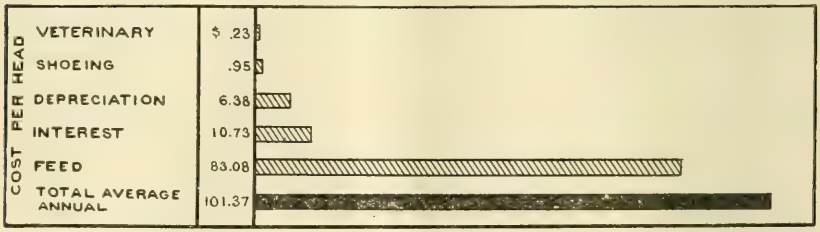

FIG. 13.—Proportionate cost of various items and the total annual cost of maintaining workstock per year (115 farms, Ellis County, Tex.).

Table XVIII shows the stock kept and feed on the average cotton farms of the region. The average value of feed raised per farm is $578 and the average value of feed bought per farm is $91. The total value of feed consumed per farm amounts to $516 or $55 per animal unit. Other data (see fig. 13) shows that the value of feed consumed by work stock is $83 per head. The average value of feed consumed by productive stock is therefore $19 per animal unit.

The following diagram, showing factors affecting the principal enterprises, is practically self-explanatory. It is intended to visualize briefly the summary of conditions, favorable or unfavorable, to the principal enterprises of the region.

[a] For definitions of the term "animal unit" see p. 3.

FACTORS AFFECTING PROFITABLENESS OF ENTERPRISES.

Enterprise.	Favorable conditions.	Unfavorable conditions.
Cotton	Cash crop—fair profit. Soil and climatic adaptation. Favorable market conditions. Utilizes labor of whole family. Size of farm. Low machinery requirements.	Depletes soil. Uneven distribution of labor. Keeps children from school for picking. Small percentage horse labor utilized. Root-rot.
Corn	Feed crop. Supplements cotton in labor distribution. Soil.	Depletes soil. Local market limited.
Oats	Utilizes labor otherwise unused. Winter pasture.	Climatic conditions—drought. Smut, rust. Big machinery requirements. Requires large amounts of labor for harvest and thrashing.
Sorghum	A sure crop-hay. Good yields. Drought resistant.	Limited market. Depletes soil rapidly. Very difficult to handle.
Wheat		Climatic conditions. Large labor requirements for thrashing. Requires big machinery.
Alfalfa	Improves soil. Even labor distribution. Fair yields.	Limited market. Root-rot. Presence of Johnson grass. Drought.
Stock	Utilizes waste feed. Soil improvement. Furnishes supplies for home consumption.	Limited pasture. Less profitable than cotton. Poor quality.

COST OF PRODUCTION.

Before discussing in detail the cost of production of the various crops found on the farms of Ellis County, a brief discussion is here given of the methods used in the determination. The items of cost considered were as follows: Rent of land; man labor, consisting of hired labor, family labor, and the operator's own labor; horse labor; equipment or machinery cost; interest on cash required to operate the farm; seed cost; ginning cost for cotton; and special costs on certain enterprises.

The rent of land was ascertained from each farmer. All cotton land when rented was worked on the share basis, one-fourth of the crop generally being the landlord's portion. All other crops, such as corn, oats, sorghum, and milo maize, when raised on rented land were produced either on the share basis or cash-rent basis. More often these crops, when raised by tenants, were produced on land for which cash rent was paid; for those crops where the landlord received a share as rent his portion was generally one-third of the crop produced. Since nearly 40 per cent of the land covered by the survey was worked by tenants, there was no difficulty in determining the cash rent per acre on any of the farms.

Since the rent per acre was determined on the basis of the amount that the landlords received as rent, this item covers a number of minor expenses, such as taxes, insurance of farm buildings, repairs of same, and building depreciation. The rent is determined, to a certain extent, by the yielding power of the land.

In arriving at the cost of man labor the three component parts were determined separately. The cost of hired labor, consisting of month hands, day hands, and contract work, such as cotton chopping, picking, etc., was obtained directly from each farmer. If any members of the family did field work, the value of this was obtained and considered as a cost. The value of the operator's own labor was obtained on the basis of what it would cost him to hire another to do his work of management and manual labor equally as well as he himself could do it. It is appreciated that this is an unsatisfactory figure, but tabulations have shown that on the average the farmers were consistent in their estimates of this figure. When rations were furnished laborers, or where members of the family did farm work, the cost of food bought or furnished this labor was included in the man-labor cost.

The cost of horse (or mule) labor was subdivided into the following items: Depreciation; interest on investment in work stock at the beginning of the year; feed cost; shoeing and veterinary charges; and cost of work stock hired by the month or year. Where a crew, consisting of men, team and machinery, was employed for a specific

purpose, the cost was charged directly against the enterprise on which the labor was performed. These items were totaled to make up the total cost of horse labor.

The equipment cost includes depreciation, repairs, interest, and insurance. The items of interest, taxes, and insurance together were found to be approximately 10 per cent of the value of the machinery, and this figure was therefore used in all calculations involving equipment cost. These items were totaled to determine the equipment or machinery cost per farm.

A certain amount of cash is required to run the business of each farm. In each case this amount was ascertained and interest at the rate of 8 per cent was charged on this figure.

The amount and value of seed required per acre were arrived at for each crop and the value was charged directly against the respective enterprises.

The cost of ginning cotton per bale was learned for each farm and was charged directly against this crop.

Various special costs, such as those for harvesting and thrashing grain, binder twine, baling hay, etc., were determined and charged directly against the respective enterprises. The number of days of productive labor was ascertained for each farm. This was learned by determining the acreage of each enterprise, the crew duty for each operation, and thus the number of days of productive man and horse labor for each crop. From the number of days of work utilized in the handling of productive stock, as well as in other minor enterprises, and the number of productive days of work outside of the farm, such as road work, outside hauling, etc., the total number of days of man-labor and of horse labor were arrived at for each farm.

Having ascertained the number of productive man days and horse days, the costs were prorated to the respective enterprises as follows: Costs of man labor and interest on cash to run the farm were distributed according to the number of productive man days required for the respective enterprises; the cost of horse labor and equipment cost were distributed to the enterprises according to the number of horse days required for each enterprise.

In this manner the costs were charged against the crops on the acre basis; these distributed costs, together with the separately apportioned special costs, were totaled, thus arriving at the acre cost of each crop. The yield per acre of each crop being known, the unit cost was calculated.

In the case of cotton two products are obtained from the gin, namely lint and seed. The total acre cost of cotton was distributed between the lint and seed according to the acre value of each product, on the basis of the net weight per bale of cotton, and the amount of seed produced per bale of lint.

The average rent of land was found to be $5.10 per acre. The rent of cotton land is slightly lower than land rent for the other crops, although the difference is very small.

MAN LABOR.

In Table XIX is shown the distribution of man labor cost per acre of all crops. It is seen that the total average cost is $8.76. That portion of the man labor cost in hired labor amounts to $3.39 per acre, while family labor amounts to $1.73. The operator's own labor is valued at $3.64 per acre. It was found that the cost of the operator's labor per acre decreases slightly as the size of the farm increases. The other items composing the man labor cost did not vary with the size factor to any appreciable extent.

TABLE XIX.—*Distribution of man labor cost for all crops (114 farms, Ellis County, Tex.*

	Cost per acre.
Paid or hired labor	$3.39
Family labor	1.73
Operator labor	3.64
Total man labor	8.76

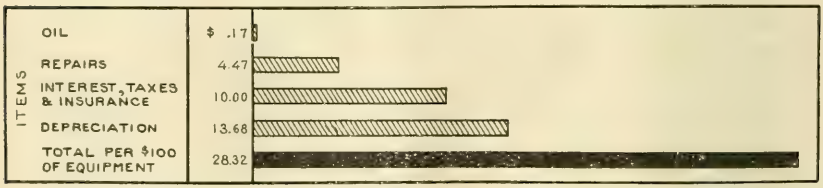

FIG. 14.—Cost of various items and total annual cost per $100 of valuation of operating machinery (115 farms, Ellis County, Tex.).

As the size of farm increases, the total amount of hired labor increases. The amount of hired labor per crop-acre is slightly higher on the larger farms, the average for all farms being $3.38. The total hired labor for the average farm is $397.

The total value of the labor of the operator's family increases as the size of farm increases, but the value per acre is slightly less on the large farms. The average total value of family labor on all farms is $203.

The average total value of the farmer's own labor on all farms, averaging 117.5 acres in size, is $427 per year. As the size of farm increases, however, the total value of the operator's labor increases, but not in proportion to the size. The value of the operator's labor on the group of farms averaging 62.5 acres is $4.45 per acre; on farms averaging 100.1 acres, $4.04; on farms averaging 188.9 acres, $3.17, and on all farms, averaging 117.5 acres, $3.64.

HORSE LABOR.

The average annual cost of work stock per head is $101.37[1] (see fig. 13). The average cost is almost exactly the same on large farms as on small. However, the cost per acre and the cost per day decrease materially as the size of farm increases. The annual feed cost per animal amounts to $83.08. The average value of this stock is $135 per head and the interest on this valuation at 8 per cent amounts to $10.73.

The annual depreciation of work stock is comparatively low on these farms, averaging $6.38. Very little shoeing is done for ordinary farm work; only where teams are used for hauling on the

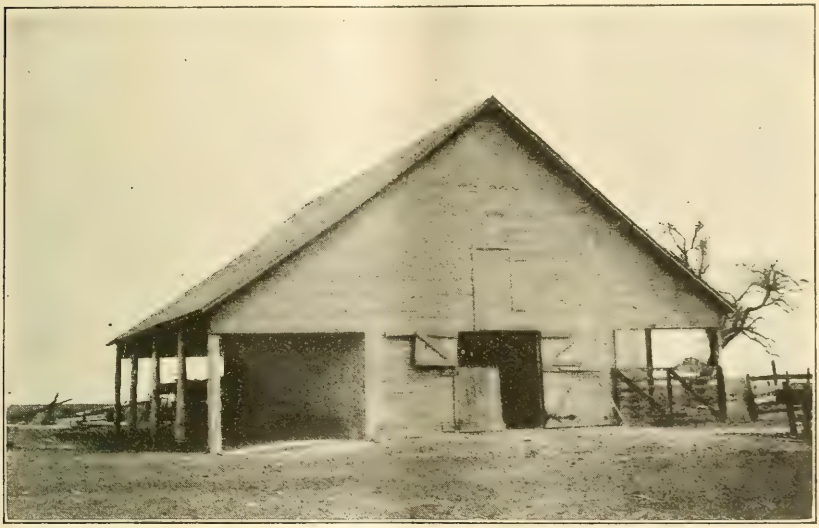

FIG. 15.—Barn, with overhanging eaves for machinery shelter.

hard pike roads are they shod. The average cost per head per year is seen to be only $0.95. The veterinary cost is but $0.23 per head. Only an occasional animal is injured and very little disease is found in the region.

COST OF MACHINERY.

The cost of maintenance and operation of machinery and tools is comparatively high in Ellis County. Figure 14 shows the relation of the various cost items to each other and to the total cost per $100 of equipment. The largest item is seen to be depreciation, which is equivalent to 14 per cent of the value of the machinery. According to this rate, the average life of machinery for the region is about 7

[1] This figure does not include cost of labor in caring for work stock. This labor is included in the nonproductive labor, all of which is distributed to the various enterprises.

years. There are two apparent causes for this high rate of depreciation of machinery. First, the farmers are not certain as to which cost is greater—to construct and maintain buildings for housing machinery (see fig. 15) or to allow the small amount of machinery required on the cotton farms to stand in the fields; as a rule, machinery sheds have not been constructed. Second, a large proportion of the farms are operated by tenants who own the equipment but do not own the buildings. The landlords are loath to construct buildings for the protection of machinery not their own. Depreciation of machinery represented 48 per cent; interest, taxes, and insurance, 35 per cent; repairs, 16 per cent; and fuel and oil, 1 per cent of the total annual machinery cost.

Figure 16 shows the relative cost of the various items after these were prorated to the acre basis. The total average acre cost of all

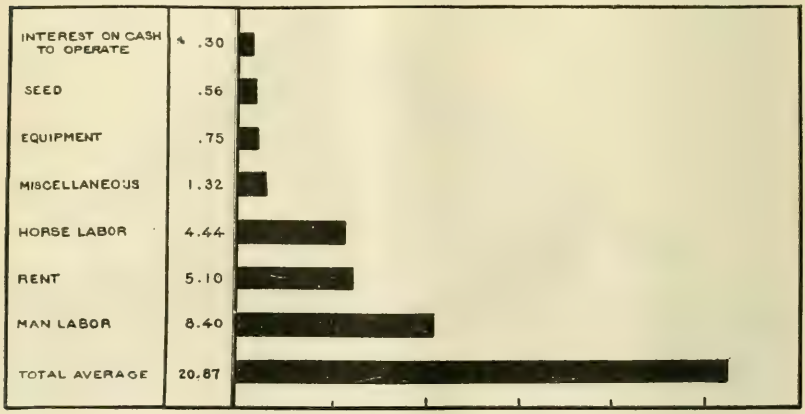

FIG. 16.—Cost of various items and total average acre cost of production of crops (115 farms, Ellis County, Tex.).

crops is seen to be $20.87, which is made up of the various items as follows: Man labor, $8.40; rent of land, $5.10; horse labor, $4.44; miscellaneous costs, $1.32; equipment cost, $0.75; seed, $0.56; and interest on the cash required to operate the farm, $0.30.

TABLE XX.—*Productive work units per acre on crops (114 farms, Ellis County, Tex.).*

Crop.	Man days per acre.	Horse days per acre.	Crop.	Man days per acre.	Horse days per acre.
Cotton	5.65	3.17	Alfalfa	3.49	4.96
Corn	1.99	3.27	Wheat	.72	1.27
Oats (grain)	.78	1.53	Miscellaneous	1.09	1.23
Oat hay	1.04	1.85	Average on all crops	4.77	3.19
Sorghum	2.02	2.94			

As previously stated, various costs were prorated to the enterprises according to the number of days of productive labor of man and

horse required, respectively. The data in Table XX show the relative amount of labor required for the various crops. Cotton requires an average of 3.17 days of horse labor per acre; two crops require more horse labor per acre than cotton, namely, corn and alfalfa, although sorghum requires nearly as much, being 2.94 days per acre.

Cotton requires more man labor than any other crop raised, being 5.65 days per acre. Alfalfa is next in amount required, being 3.49 days.

The grain crops of oats and wheat are noticeably low in amount of both man and horse labor required.

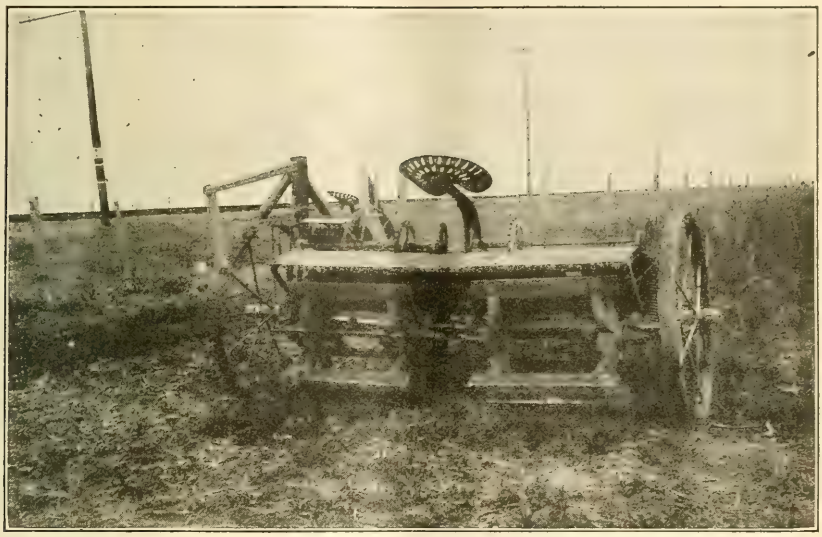

FIG. 17.—Type of two-row stalk cutter. The one-row cutter of the same type is more common.

RELATION OF AMOUNT OF TILLAGE TO COST.

There is a distinct relation between the amount of tillage and the cost of production. A group of 23 farms put an average of 2.88 days of labor on cotton, making a yield of 250 pounds of lint, at a cost of approximately 8.3 cents per pound. Another group of 21 farms, averaging 4.12 horse days per acre, produced cotton at a cost of 9 cents per pound.

The effect of these increased costs due to excessive tillage is noticeable in the returns on the investment. When 2.88 horse days were utilized, there was a return of 7.4 per cent, and where 4.12 horse days were used the return on the investment was only 5.8 per cent. The other groups ranged between 7.4 per cent and 5.8 per cent income on the investment when the tillage was between the limits above mentioned.

These data indicate that approximately three days of horse labor per acre gives the most profitable amount of tillage, either more or less than this amount showing a decrease in the net returns. The number of work animals making up the various crews will have some bearing on this figure; the larger the crews the less horse labor is required to accomplish the same results.

In figures 17 and 18 are shown types of implements utilized in cotton production. Each of these machines requires the use of two

FIG. 18.—A new type of stalk cutter which works on the principle of the lawn mower.

or more animals; by such utilization large acreages are covered in a day's work.

A study of figure 19 brings out the relation of the various items of cost to each other and to the total acre cost of cotton. It will be remembered that the average yield of cotton is 241 pounds of lint principal crops found on the 114 farms of Ellis County on which the various items are as follows: Man labor, $10.04; rent of land, $5.08; horse labor, $4.47; ginning, per acre, $1.49; equipment, $0.73; seed, $0.50; and interest on cash to operate the farm, $0.34.

A comparison of these items of cost with the same items for the average acre cost shows that man labor is considerably higher than the average and horse labor and equipment costs are slightly higher. Rent of land and seed cost of cotton are slightly lower than the average.

In Table XXI are given a summary of costs and values for the principal crops found on the 114 farms of Ellis County on which costs were determined. The average cost of cotton per acre is $22.65, the yield being 241 pounds of lint and 456 pounds of seed (Table

XXII). The value of lint and seed is $30.60 per acre. The lint cotton cost 8.3 cents per pound and sold at an average price (for 5 years) of 11.2 cents per pound.

TABLE XXI.—*Cost per acre, value, yield, and cost per unit of various crops (114 farms, Ellis County, Tex).*[a]

Crop.	Number of farms.	Cost per acre.	Value per acre.	Yield per acre.	Cost per unit.	Value per unit.
Cotton	114	$22.65	$30.60	241 pounds	$0.083	$0.112
Corn	109	14.92	20.76	25.6 bushels	.584	.81
Oats	23	10.44	9.91	19.7 bushels	.53	.51
Oat hay	74	13.12	12.59	0.94 ton	13.97	13.39
Sorghum	79	20.77	33.03	2.8 tons	7.42	11.81
Alfalfa	8	26.80	38.57	2.51 tons	10.67	15.36
Other crops	107	16.75	23.88			
All crops, average	114	20.87	27.72			

[a] Weighted averages—that is, averages for the total acreage on all farms, considered as one farm. The averages are not averages of the average for each farm. The data are for 1914.

The average yield of corn is 25.6 bushels per acre, at a cost of $14.92. The average cost per bushel is 58.4 cents and the average value is 81 cents.

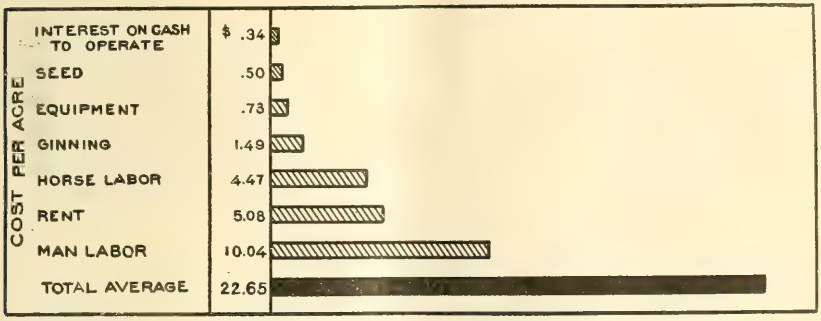

FIG. 19.—Cost of various items and total acre cost of cotton (115 farms, Ellis County, Tex.)

In 1914 the value of both oats and oat hay was less per acre than the cost. Oats for grain cost 53 cents per bushel and were worth 51 cents, while oat hay cost $13.97 per ton and was worth only $13.39. These data should not be considered reliable, on account of the fact that the yield was below normal.

The acre cost of both sorghum and alfalfa are comparatively high, but fair yields are made, so that the cost of sorghum per ton was $7.42 and of alfalfa $10.67. Sorghum hay is valued at $11.81 per ton, but scarcely any of this product is sold. Alfalfa sold for an average of $15.36 per ton.

There appears to be justification for extending the production of alfalfa. There can be no doubt of this as long as the market price stays at about $15 per ton. There can be but little doubt that from the standpoint of fertility of soil there should be an extension of this crop.

TABLE XXII.—*Cost and value of lint and seed (11 farms, Ellis County, Tex.).*

Cost of lint and seed per acre	$22.65
Proportionate cost of lint per acre	19.83
Proportionate cost of seed per acre	2.82
Cost of lint per pound	.083
Cost of seed per ton	12.34
Value of lint and seed per acre	30.60
Value of lint per acre	26.99
Value of seed per acre	3.66
Value of lint per pound	.112
Value of seed per ton	16.03
Yield of lint per acre ... pounds	241
Yield of seed per acre ... pounds	456

Table XXII shows the distribution of cost and value of cotton between lint and seed. Prorating the acre cost of lint and seed in proportion to the acre value, it is seen that seed costs $12.34 per ton. The average price received for seed is $16.03 per ton.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 660

Contribution from the Office of Public Roads and Rural Engineering, LOGAN WALLER PAGE, Director

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HIGHWAY COST KEEPING.

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Reviewed by Halbert P. Gillette, *Consulting Cost Engineer.*

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PART I.

COST KEEPING IN GENERAL.

THE FUNDAMENTALS OF COST KEEPING.

Definition.—Cost keeping is a system for recording the cost of each unit of product or division of work in order to facilitate comparison of such costs with cost of other similar units or divisions under like conditions. Cost keeping analyzes each unit of product or work to determine the reasonableness or unreasonableness of the cost, and also to secure an intelligent basis for predicting the cost of producing similar units in future.

Lack of cost records.—The Office of Public Roads and Rural Engineering, in an extensive investigation of highway management, both by the State highway departments and by a large number of individual counties and townships, brought out, among other conditions, the very general absence of cost keeping. Few examples of practical and efficient cost keeping were found in operation, and

these were confined largely to the State highway departments. Only in rare instances were cost-keeping systems found in counties or townships. This condition is due largely to the notable scarcity of information available on the subject of highway cost keeping, as practically all textbooks on cost keeping have been prepared from the viewpoint of factory management and are not readily adaptable to highway work. Furthermore, the usefulness of highway cost data has not yet been generally appreciated by public officials.

Purpose of the bulletin.—The purpose of this publication is to present, first, in an elementary way the principles which govern cost keeping; second, a practicable application of those principles to highway work.

Development of cost systems.—Cost keeping was developed in the manufacturing industries. To Charles Babbage has been conceded the honor of having first called the attention of the manufacturing world to its desirability, in 1832, in his publication entitled "The Economy of Manufacture." Half a century elapsed, however, before factory managers, forced by relentless competition to eliminate waste and incompetency from their factories, began to introduce systems of cost keeping.

Since 1900 the use of cost keeping in manufacturing industries has developed steadily. During this period of development principles regarded as basic have been established. While cost keeping for highway work is of comparatively recent origin, it is based upon factory cost keeping, and the same principles govern.

COST ELEMENTS.

The term "cost," as generally interpreted and as used in this bulletin, is the summation of expenditures expressed in terms of money involved to acquire or produce a utility or to perform a service.

The cost of every unit of product, whether it be a square yard of road surface maintained, or a cubic yard of concrete which is a part of a bridge or culvert, is composed of four basic elements of expense, namely:

(1) The cost of labor.
(2) The cost of materials.
(3) The cost of service of plant and equipment.
(4) The cost of general expense or overhead.

LABOR.

The costs of labor are divided into two classes; first, direct labor cost; and, second, indirect labor cost. All labor chargeable against the product which can be designated as directly expended on it is called direct labor. All labor chargeable against production and not directly expended on the product is called indirect labor.

For example, the cost of men using picks and shovels on excavation who are directly expending their efforts on that piece of work is a direct labor charge. A superintendent in charge of a road job is not directly expending labor on excavation, but is engaged in directing the prosecution of all kinds of work and his expense is an indirect labor charge, chargeable pro rata against the production of all the work units he may be supervising. Other examples of indirect labor are the services of watchmen, timekeepers, and water boys.

MATERIALS.

Materials also are divided into two similar classes—direct and indirect. All materials entering the product as an integral part of its composition are called direct materials. All materials chargeable against the production but which do not enter directly into the product as an integral part of it are called indirect or expense materials or sometimes supplies. The cement, stone, and sand that are mixed together to form the concrete of which a concrete road is constructed are all direct materials, but the oil used for lubricating and the gasoline for operating the mixer in which these materials are prepared for use are indirect materials or supplies. It is easy to charge direct material cost, but often it is very difficult to charge to each product its correct share of indirect material cost.

Small, or hand, tools not used as a part of some plant unit and which have such a short period of usefulness that they are seldom used on more than one job, usually are considered supplies and therefore are part of the indirect materials charged to the work.

PLANT AND EQUIPMENT.

"Plant" includes such physical property used on the work as land, structures, machinery, live stock, and tools of a more permanent character than those referred to as supplies. "Equipment" is a less inclusive term and is interpreted generally to mean the smaller and especially the movable plant units. The cost of the service of "plant" can be charged most readily in the form of a daily rental against the work upon which it is used. This rental should be charged whether the equipment be owned by the operating organization or leased from other owners. It consists of "operating charges," which are—

(*a*) The expense of operation,
(*b*) The average cost of repairs,
(*c*) Charges for the time spent in idleness,

and "fixed charges," which are—

(*d*) Charges for depreciation,
(*e*) Interest,
(*f*) Taxes,
(*g*) Insurance.

The expense of operation.—This includes the wages of operators and helpers and the cost of supplies during the periods of operation. Usually these are charged directly against the work done and not included in the plant rental. It is only necessary that they be charged in one place or the other, and it is important to specify what is included in rental when leasing equipment.

The average cost of repairs.—There is a difference of opinion among cost accountants as to how repairs and renewals to plant should be charged. One view is that renewals may be of such a nature that the useful life of the machine has been increased and therefore the expense of such renewals should be looked upon as an offset to depreciation. Another view is that there is no difference between repairs and renewals, except in degree, and that they all should be considered in the same light; i. e., independent of depreciation charges. It appears that the latter consideration permits simpler accounting and does not rely so much upon individual judgment as to whether the expenditure is for repairs or for renewals.

After a machine has been rebuilt or repaired extensively with the intention of increasing its serviceable life, it should be considered as a piece of new equipment valued at its depreciated value, plus the cost of renewals. This necessitates the computing of a new rate of depreciation on the basis of the new value and assumed new useful life.

The approximate average cost of repairs, including extraordinary repairs, often can be arrived at by casting up old accounts and finding what a similar piece of machinery used on similar work has cost for repairs over a term of years.

Charges for time spent in idleness.—To arrive at a fair and equitable daily charge for rental some allowance must be made for time spent in idleness, because on these days the fixed charges still are continuing and certain supplies are necessary even though the machine be not in operation. The usual way of arriving at the charge for lost time through idleness is to bring together all of the charges for a year and divide them by the number of days the machine actually was in use. By dividing the sum total of expense by the number of days the machine was available for use even though no work existed on which it could be used, the result would be a daily rental with no allowance for lost time. The difference between these two rentals will show what a considerable factor in the fixed charges this item of lost time may become. In all contracts or agreements on rental of equipment care should be taken to specify whether the rental is "per day" or "per day of service."

Charges for depreciation.—Equipment is consumed in production just as truly as material. This loss is called natural depreciation. Depreciation may be either natural or functional. "All equipment

progresses steadily toward the scrap pile, starting the date it is purchased, and while its progress may be delayed it can not be prevented by repairs." [1] It is as much an expense on a steam roller as the cost of fuel burned in the fire box. In the case of fuel the expense is immediate; in the case of depreciation the expense is extended over a period of time. Functional depreciation is loss due to the obsolescence or inadequacy of equipment.

There is no doubt in the minds of cost accountants that depreciation of plant and equipment should be included as a charge against operation, but there is considerable difference of opinion as to how depreciation should be computed.

Three factors determine in all cases what the depreciation should be: First, the original cost; second, the length of useful life; and third, the scrap value of the machine when it no longer can be used for the purpose for which it was purchased, or the salvage value, if it is to be considered as a "second-hand" piece of equipment. Knowing these factors, the problem resolves itself into how to divide the difference between the original cost and the scrap or salvage value (called total depreciation or wearing value) over the length of the useful life of the machine. A number of formulas have been devised for computing decrease in value or depreciation. Fish, in his textbook on "Engineering Economics," explains five such formulas. Three of the more commonly used are the straight line, the declining balance, and the sinking fund.

The first is recommended as the simplest and perhaps best method for road work. By this method the total depreciation is divided by the number of years of useful life and the quotient charged off as a yearly depreciation. This is called the straight-line method, and its greatest advantage is its extreme simplicity.

The second method, a modification of the straight-line method, is called the declining balance method. It is based on the theory that during the earlier years of the life of any machine the repairs are smallest, and therefore to arrive at a constant charge for repairs and depreciation, the depreciation must be heaviest in the earlier years of the life of the machine and lightest in the last. The plan, therefore, is to charge off a fixed percentage annually from the net value of the machine. This gives a diminishing annual charge for depreciation. In the comparative table (p. 6) this annual rate is about 30 per cent. This is determined by the formula $r = 1 - \sqrt[n]{\frac{v_2}{v_1}}$ in which r is the percentage of diminishing value, n the life of the equipment in years, v_1 the original value, and v_2 the scrap value.

[1] Modern Accounting, by H. R. Hatfield.

The third method is called the sinking-fund method. It is based on the assumption that the depreciation on a structure at any time is equal to the accumulations of a sinking fund established for renewal at the end of its useful life. The depreciated value plus this sinking fund (actual or imaginary) at any period equals the original cost.

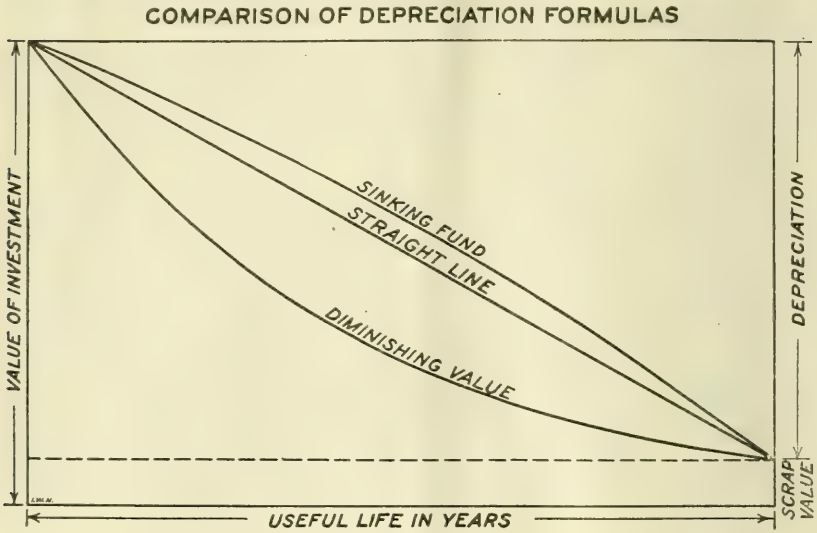

FIG. 1.

It should be observed that none of these formulas takes into consideration interest on investment, output, cost of operation, or maintenance charges. Figure 1 gives a graphic comparison of the above formulas.

The following table is a comparison of the annual depreciation on a $600 machine that has an assumed useful life of five years. It also is assumed that at the end of this period it will have a scrap value of $100. The annual depreciation is computed by the three formulas described:

Comparison of three methods of computing depreciation.

Years.	Straight-line method.	Diminishing-value method.	Sinking-fund method, 6 per cent interest.
First	$100	$180.72	$88.70
Second	100	126.28	94.02
Third	100	88.25	99.66
Fourth	100	61.67	105.64
Fifth	100	43.08	119.98
Total	500	500.00	500.00

The theory of natural depreciation, epitomized, is that all equipment, even if kept in the best of repair, in time will reach a state where repairs no longer are sufficient to keep it in economical working condition and the entire machine must be renewed. The fund created by the depreciation charges is intended to supply the money to purchase a new machine to take the place of the one expended, or to retire the original investment in case the machine no longer is needed.

Any of the depreciation formulas is satisfactory in determining rental charges, provided the assumed life of the machine be approximately correct. As the assumption of the useful life of the machine may be the source of considerable error, there seems to be little argument for the finer calculations as to methods of distributing the depreciation.

It will be found convenient in computing depreciation to group elements of the plant having approximately the same serviceable life. This will have the advantages of requiring fewer accounts and tending to equalize high and low assumed machine life.

Repairs and renewals are charges due to breakage or the wearing out of expendable parts of equipment. It is obviously incorrect to charge to repairs or renewals any improvements or betterments added to any piece of equipment. When such improvements have been made the cost should be added to the present value of the machine and a new depreciation computed upon this new value. An example of such a case would be the addition of a conveyor to an old stone crusher for the purpose of doing away with shovelers. The The improvement is not a repair of any broken parts or a renewal of any part worn out by the continual use of the machine; it is a new feature which adds to the value of the crusher. A rebuilt second-hand machine may be considered in the same light.

Interest, taxes, and insurance.—Interest should be charged on the investment at the rate paid or the prevailing rate, where there is no indebtedness.

Taxes, as paid, should be charged in the rental rate.

Insurance should be charged either as paid or at the prevailing rates if the organization carries its own risk.

Fixed charges are discussed further on page 9. A table of plant rental is included in the Appendix.

GENERAL EXPENSES.

The fourth element of cost is general expense. It often is called "overhead" or "burden," terms derived from factory cost keeping, the use of which in highway-cost keeping is not recommended.

General expense includes all charges that can not be connected directly with the cost of labor, material, and plant. For convenience in accounting and for the purpose of securing a desirable division of road cost, general expense will be considered as divided into two

classes. One will be referred to as "engineering and supervision" and will include those items of inspection and engineering which can be charged directly to the project. The other class will be referred to as "administration expense" and include those expenditures incurred in conducting all the activities of the department which are so general in character that they are not assignable directly to any particular project.

The desirability of separating the project cost of engineering and supervision from administration cost and unit costs will be apparent after a little consideration. The work of the engineer in preparing the plans and specifications affects labor and material costs only in the kinds and amounts that may be required and not at all in the efficiency of their expenditure. By carefully worked out profiles and cross-sections an engineer may reduce the yardage of excavation required, but such planning may not reduce the cost per unit of excavation. To secure efficiency in operations is the function of the superintendent or the foreman who is responsible for the cost of such operations. If engineering and supervision cost is incorporated in unit cost, an element is included over which the foreman or superintendent has no control, and his efficiency is obscured thereby. If, on the other hand, engineering and supervision cost is included in the charge for administration, it is placed in a class of expenditures over which the engineer has little or no control.

Highway administrative organizations are prescribed largely by statute and the attendant costs necessarily are dependent, in a large measure, upon the form of the organization, the various duties required, the methods of financing, and many other factors, all of which are conditions imposed by legislation. To include with these administrative costs the cost of project engineering and supervision would mean the loss of valuable comparable information on the efficiency of the divisions of an organization and one type of administrational organization with another.

Administration.—Administration costs include such expenditures as salaries and expenses of the executive officers, legal services, maintenance of office, departmental engineering, investigations, experiments, clerical staff, fiscal operations, and miscellaneous fixed charges. These expenditures can not be allocated directly to any particular class of work or to individual projects.

Cost accountants have devised numerous ways of distributing general expenses to the various classes of work. Most of these, however, are not practicable in the distribution of such expenses on road work. Since indirect labor and indirect materials are distributed directly in the unit costs, and engineering and supervision are chargeable directly to projects, the remaining portion of what would be considered "burden" by factory cost accountants is comparatively

small in proportion to the aggregate expenses. Any portion of general expense that can be assignable directly to a project should be charged against such project. The remainder should be prorated over all the project expenditures for the period.

Engineering and supervision.—To engineering and supervision should be charged all expenditures for surveys, plans, specifications, estimates, tests, and all engineering inspection and supervision in the nature of oversight required to secure the proper execution of the work. Such expenditures can be charged directly to individual projects.

FIXED CHARGES.

Fixed charges are those items of expense which go on practically unchanged irrespective of the activities of the organization. Those fixed charges which pertain to the production plant have been discussed in relation to plant and equipment. Certain fixed charges not immediately connected with production operations may best be considered as a part of general expense. Thus depreciation, interest, taxes, and insurance are elements of expense also in relation to the plant and equipment of the administrative organization, such as buildings, office and laboratory equipment, instruments, machines, and similar items.

In the practical application of cost keeping, fixed charges are considered only in so far as they aid in the determination of efficiency, and their inclusion as an item of cost is a question of accounting. Where fixed charges result from methods of financing rather than the methods of doing the work they belong to the field of bookkeeping and not cost keeping. Thus, where a county issues bonds for road improvement the interest is a fixed charge which must be paid and so increases the total outlay for the improvement but has no relation to the efficiency with which the work is executed, and is, therefore, a matter of bookkeeping and not cost keeping. Where two crews are engaged in excavation, one with power tools and the other with hand tools, fixed charges are of prime importance to the cost keeper for the purpose of determining efficiency and the cost of operation in each case.

It is customary among contractors to include all fixed charges as a part of the expense of work, and therefore they appear in the unit prices of their itemized bids. In making up his estimates on unit prices to check against submitted bids, the engineer therefore should include among other fixed charges interest on capital invested in plant and on necessary operating capital, for materials, pay roll, and deferred payments.

Considerations of fixed charges are also important in the selecting of equipment and determining upon types of improvements. These considerations are, however, within the field of engineering

economics and not cost keeping, although cost data have a most important part in the final determination.

HIGHWAY COST ANALYSIS.

An analytical chart has been prepared to place before the reader in concise and convenient form a summary of the foregoing discussion of cost elements applied to road work, and to show the relation between the cost elements and the final cost of the project as expressed in totals and by units. The first column of the chart contains the four basic elements of cost. Opposite each element, in the second column, are the classes of expenditure, such as direct, indirect, etc. The third column shows in detail the specific application of the cost. Example, "for materials," "for labor," "superintendence," etc. The fourth column contains a tabulation of the class of product resulting from the cost outlay, such, for example, as construction, maintenance, right of way, etc. The fifth column contains the final cost and presents it by units, by project, etc.

Highway cost analysis.

	Elements of cost.	Classes of cost.	Application of cost.	Product of cost.	Summary of cost.
Highway cost	Labor cost	Direct	Wages of laborers, mechanics, teamsters, etc.	Construction, maintenance, or reconstruction of road parts, right of way, grade and roadside, roadway, ditches, drains, bridges, and culverts, and supplementary parts.	By units, direct, as performed.
		Indirect	Wages and expenses of superintendents, foremen, timekeepers, guards, watchmen, water boys, etc., lost labor days, labor expense.		
	Material cost	Direct	Materials entering into product as integral parts.		
		Indirect	Supplies, used but not as a part of product.		
	Plant and equipment service cost.	Operating	Operation. Repairs. Idleness.		
		Fixed	Depreciation. Interest. Taxes. Insurance.		
	General expense cost.	Project: Engineering and supervision.	Salaries and expenses of engineers, field parties, draftsmen, inspectors, and clerks; office expenses, tests, and miscellaneous expenses for individual projects.	Plans, specifications, estimates, surveys, inspection, and direct supervision of work.	By project; upon completion may be apportioned to units.
		General: Administration.	Salaries and expenses of executive, engineering, legal, and clerical staffs; expense of office maintenance, experiments, investigations, and fiscal operations; miscellaneous fixed charges.	General direction, policy, oversight, planning, control, legal, and financial provisions.	On all operations over a period of time and apportioned to projects.

UNITS OF MEASUREMENT.

Care should be taken in selecting the units on which to collect cost data. Too many and varied units will make the system cumbersome and expensive, while too few may impair its value seriously. Furthermore, the units of measurement adopted for any cost-keeping system or project must be definite, expressive, readily obtainable, and familiar. Thus, for example, the ton and the cubic yard as applied to broken stone are definite units and afford a ready and accurate comparison, but the square yard when applied to a finished macadam road is indefinite until additional information as to the depth of the material is available. Similarly, many units, such as wheelbarrow, wagon, truck, or carload, while often convenient units of count in the field, are indefinite and always should be reduced to definite comparable units, such as cubic yard or ton.

The units selected must, so far as possible, be expressive of definite operations. Thus, while in engineering construction the cubic yard is a very common unit upon which contract prices are based, it frequently is a very uncertain unit of performance, as it is a composite of other units. For example, in rock excavation there are involved the following operations: (1) Drilling, (2) blasting, (3) breaking large chunks, (4) loading into carts, wagons, cars, or the like, (5) transporting, (6) dumping.

The important item of drilling depends largely on the necessary spacing of the drill holes, which varies in the different kinds of rock and in different kinds of excavation. Clearly, then, the linear foot of drill holes is the unit for measuring the output of the drillers, and not the cubic yard. Transporting the rock is largely a function of distance; hence the unit of transportation cost should be the ton or yard carried 100 feet or 1 mile, and not the cubic yard without the factor of distance.

The units must be obtainable readily or the cost of collecting the necessary data will be too high. Thus, for example, to obtain the exact cubic yardage and the distance it was moved in preparing the subgrade for a macadam road with a road machine would be not only difficult, but expensive. Hence for this class of work the readily obtainable, though less definite, unit of the square yard usually is adopted.

That the full value of the cost-keeping system may be realized, the units in which the data are expressed must be familiar to those charged with their collection as well as to those who are to profit from their use. Thus, the cubic meter is as definite a unit for measuring earthwork and generally as readily obtainable as the cubic yard, but to the average roadman it has little or no meaning until translated into the terms in which he is accustomed to think. If

any one of two or more units otherwise would answer equally well, the one most familiar and generally used always should be adopted.

There are many units so closely related to the desired unit of measurement that with very little computation they can be transformed into the desired unit. For example, the knowledge of the number of bags or barrels of cement used and the proportion of the mixture of the concrete are functions which at once determine the amount of sand and stone used. A number of tables giving some of the more common and convenient units of measurement used in collecting and compiling cost data relating to road work, are given in the Appendix.

PART II.

COST KEEPING FOR HIGHWAY WORK.

ESSENTIALS OF A COST SYSTEM.

Certain fundamental principles must be followed to make any cost system successful. This applies to road costs as well as to factory costs. Any cost-keeping system to be successful must be (1) reliable, (2) simple, (3) immediate, (4) flexible, and (5) relatively inexpensive.

(1) Reliability is of paramount importance. If the data collected are not reliable, all records based upon them of course will be misleading and the results dangerous. Accuracy is desirable, but this need not be carried beyond the practical limits adopted for measuring the units of materials expended and the units of work accomplished.

(2) If simplicity be not maintained the purpose of the system will be defeated. Involved and complex forms are confusing to the recording officials, difficult to compile for study and analysis, and apt to be inaccurate and a useless expense.

(3) To be effective, the cost records must be susceptible of immediate analysis and must reach the officials responsible for the economic progress of the work in time to be of use. If a week or 10 days must elapse before wasteful methods and incompetency are discovered the information is past history and it may be too late to try other methods which might rectify the detrimental condition.

(4) Flexibility is very desirable. The system must be elastic enough to provide for the recording of all classes of work, irrespective of the size of the project, without any material change in the prescribed forms.

(5) Finally, the system must be relatively inexpensive. The cost of determining cost must be reduced to a minimum. If expense of obtaining cost records to point out the way to efficiency is not much below the saving effected, they have no just claim to a place in any plan of management.

CLASSIFICATION OF EXPENDITURES.

The first problem in developing a cost-keeping system for highway work is to devise a general classification of expenditures that will conform to accounts appearing upon the ledger of the organization; that is, at the outset the cost keeper's records must tie into the book-

keeper's accounts. The ledger, it is well to recall, contains only as debits the funds received or appropriated and as credits the payments made from those various funds summarized from a record which carries the distribution of these expenditures according to subheadings or primary accounts. It is usual to classify accounts as far as possible by departments, or with respect to certain functions for which funds are provided. Such a classification of accounts provides the first division for the cost keeper. This division gives what usually are known as the general accounts. Numbers or letters are used to represent these accounts, and in these letters or symbols we have the beginning of a code for cost keeping. The following classification and corresponding letters show a departmental division of accounts and a letter code suitable for highway work:

GENERAL ACCOUNTS.

C. CONSTRUCTION.—M. MAINTENANCE.—R. RECONSTRUCTION.—P. PLANT.—A. ADMINISTRATION.

The first three of these, it will be observed, have to do with certain road operations. It will be found upon analysis that they consist of the operations necessary to produce or preserve road parts. A subdivision of these general accounts produces what are called the primary accounts. Such a division is shown below. The accompanying numbers give a development of the cost-keeping code:

C, M, AND R. CONSTRUCTION, MAINTENANCE AND RECONSTRUCTION.

00 to 09. Right of way.
10 to 19. Grade and roadside.
20 to 29. Roadway.
30 to 39. Ditches and drains.
40 to 49. Bridges and culverts.
50 to 59. Supplementary parts.
60 to 69. Engineering and supervision.

P. PLANT.

70 to 79. Plant accounts.

A. ADMINISTRATION.

80 to 99. Administration accounts.

The numbers preceding the primary account give the range of class numbers for the final cost-keeping code. Thus 30 to 39 are the inclusive numbers for class costs of ditches and drains. This first division of the general accounts would serve very satisfactorily for a simple cost-keeping system. In such case the first set of numbers could be omitted and ditches and drains would be represented by 39 instead of the range of numbers from 30 to 39.

To obtain a system of class numbers for more detailed costs these primary accounts are further expanded as shown in the following table:

PRIMARY ACCOUNTS AND CLASS CODE.

C, M, AND R. CONSTRUCTION, MAINTENANCE, AND RECONSTRUCTION.

Right of Way.

00 Preliminaries.
01 Right-of-way surveys.
02 Right-of-way plans.
03 Real estate.
04 Damages.
09 Miscellaneous.

Grade and Roadside.

10 Cuts and embankments.
11 Shoulders.
12 Berms and slopes.
13 Trees, shrubs, grass, etc.
19 Miscellaneous.

Roadway.

20 Subgrade.
21 V drains.
22 Sub-base.
23 Base course.
24 Intermediate course.
25 Binder course.
26 Cushion course.
27 Top course.
28 Surface.
29 Miscellaneous.

Ditches and Drains.

30 Ditches and gutters.
31 Ditches and gutters, paved.
32 Blind drains.
33 Tile drains.
34 Catch basins.
35 Drainage channels.
39 Miscellaneous.

Bridges and Culverts.

40 Foundations.
41 Abutments.
42 Piers and bents.
43 Superstructures.
44 Box culverts.
45 Pipe culverts.
49 Miscellaneous.

Supplementary Parts.

50 Signs and sign posts.
51 Monuments.
52 Guard rails.
53 Curbs.
54 Retaining walls and parapets.
55 Riprap and revetments.
56 Roadside treatment.
59 Miscellaneous.

Engineering and Supervision

60 Location and relocation surveys.
61 Surveys (for operations).
62 Plans.
63 Specifications and contract preparation.
64 Estimates.
65 Expense of awards.
66 Office expenses, engineering.
67 Supervisory engineering.
68 Inspection and tests.
69 Miscellaneous.

P. PLANT AND EQUIPMENT.

70 Buildings, fixtures, and grounds.
71 Quarries, pits, material yards, etc.
72 Power tools and equipment.
73 Hand tools and equipment.
74 Livestock and vehicles.
75 Camp equipment.
76 Camp buildings and shelters.
77 Storage and transportation.
79 Miscellaneous.

} Primary Accounts.

PRIMARY ACCOUNTS AND CLASS CODE—Continued.

A. ADMINISTRATION.

80 Executive. 90 Maintenance of office. 92 Legal. 94 Clerical. 95 Fiscal. 97 Engineering, departmental. 99 Miscellaneous.	Primary Accounts.

NOTE.—It will be observed that no divisions beyond primary accounts have been provided under Plant and Administration. These can be expanded further to meet the requirements of the organization.

OPERATION CODE.

The next step is to develop a series of operations and a corresponding code which will include all the operations performed by the various departments to construct and maintain the works under their supervision. This may be accomplished in either of two ways. One is to list with each class of work all the operations that are performed under it. The other is to designate an operation by symbol and prefix this symbol with a class symbol, designating the class of work. By the first method such an operation as "rolling" would be listed under each roadway part and for both construction and maintenance. In the latter method, which is followed in this bulletin, "rolling" occurs only once in the operation code and the class code symbol is prefixed to give it the distinguishing classification. Thus any work can be indicated by combining a class code symbol and an operation code symbol.

The operation code consists of a list of descriptive phrases arranged alphabetically and designated by consecutive numbers following a dash or decimal point. This dash or decimal shows the linking together of the classification and operation codes. The operation code must include all operations necessary to be performed and the phrases must be limited to a single interpretation. The divisions of the primary and general accounts given previously form the class code. As these class code numbers represent road parts or departments of the organization, an accumulation of a number of operations for any particular road part or department is effected readily by grouping all of those having the same class number. Below is given a typical operation series for the general operations of construction, reconstruction, and maintenance of highways. A similar code could be devised for other operations.

THE OPERATION CODE.

-00 Assembling.
-01 Back filling.
-02 Blacksmithing.
-03 Blasting.
-04 Building.
-05 Building false work.
-06 Cleaning.
-07 Clearing.
-08 Clearing and grubbing.
-09 Cofferdamming.
-10 Cribbing.
-11 Curing concrete.
-12 Crushing.
-13 Dragging.
-14 Drilling.
-15 Drilling and blasting.
-16 Excavating borrow.
-17 Excavating common.
-18 Excavating earth.
-19 Excavating loose rock.
-20 Excavating solid rock.
-21 Excavating wet earth.
-22 Filling ruts.
-23 Filling washouts.
-24 Finishing.
-25 Forming.
-26 General.
-27 Grouting.
-28 Grubbing.
-29 Guarding.
-30 Harrowing.
-31 Hauling.
-32 Heating bituminous materials.
-33 Heating materials.
-34 Laying.
-35 Loading.
-36 Loading and hauling.
-37 Loosening.
-38 Mixing.
-39 Mixing and placing.
-40 Moving.
-41 Operating.
-42 Oiling.
-43 Painting.
-44 Patroling.
-45 Pile driving.
-46 Placing materials.
-47 Placing steel.
-48 Planting.
-49 Plumbing.
-50 Plowing.
-51 Pumping.
-52 Quarrying.
-53 Removing snow.
-54 Repairing.
-55 Riveting.
-56 Rolling.
-57 Scarifying.
-58 Screening.
-59 Shaping.
-60 Spreading bituminous materials.
-61 Spreading materials.
-62 Spreading screenings, sand, or chips.
-63 Sprinkling.
-64 Stripping.
-65 Tamping.
-66 Trimming.
-67 Washing.
-68 Washing and screening.
-69 Wasting materials.
-70 Water-proofing.
-71 Working on joints.
-72 Wrecking.

METHOD OF OBTAINING CLASS AND OPERATION NUMBER FROM CODE.

To procure a code number for any unit of work it is first decided what class of work is under consideration, and a number is selected from the class table. Then the specific operation is sought for in the second, or operation, table. The two are joined together with a hyphen or dash. The code letter of the department then may be prefixed to the first number and the classification symbol is complete.

If it be desired to know the code numbers to be used for recording the labor of a man mixing concrete for use as a road top course the class number for a road top course first is looked up in the class code (p. 15). This number is found to be 27; then the

operation "mixing" is taken from the operation code (p. 17) and found to be 38. Joining the two together with a dash produces the full code symbol 27–38. The letter "C" prefixed would indicate construction work, while the letter "M" would indicate a maintenance operation.

Usually no classification letter will be used, but instead the capital letter "C", "M", or "R" will be shown on the recording form. If it be desired to know what code symbol to use in order to indicate properly the time of a man spreading bituminous material on a road for maintenance purposes, the letter "M" is set down first to show that the work is that of maintenance. From the class code (p. 15) the number for a surface is found to be 28. Preceding this number with a capital letter "M" gives M–28, which shows that maintenance work has been done on a road surface. Then there is selected from the operation code (p. 17) the number for spreading bitumen, which is found to be 60. The code symbol for maintenance work of spreading bitumen on a road surface then will be M–28–60.

USE OF CODE IN OPERATIONS.

In actual use the cost keeper generally would obtain his data from the timekeeper, who would be charged with keeping time and costs. A code for use of the timekeeper would be prepared from the class and operation codes, which would have the advantage of being abbreviated and also properly arranged for the cost keeper's needs. Below is shown such a code, which was used on work where costs of the principal operations were desired, and also the expanded code, which was used where it was desired to make a more detailed study of operations for the purposes of efficiency.

TIMEKEEPER'S CODE.

ABBREVIATED.	EXPANDED.
(1)	*Grade and roadside.*
19–17 Grading—rough.	11 Shoulders:
	–56 Rolling.
	–58 Shaping.
	19 Miscellaneous:
	–07 Clearing.
	–16 Excavating borrow.
	–17 Excavating common.
	–19 Excavating loose rock.
	–20 Excavating solid rock.
	–28 Grubbing.
	–31 Hauling.
	–35 Loading.

TIMEKEEPER'S CODE—Continued.

ABBREVIATED.	EXPANDED.
(2)	*Roadway.*
20–59 Grading—fine.	20 Subgrade:
	–56 Rolling.
	–59 Shaping.
	–63 Sprinkling.
(3)	
23–26 Base course—general.	23 Base course:
	–12 Crushing.
(4)	
23–34 Base course—laying.	–31 Hauling.
(5)	
23–56 Base course—rolling.	–35 Loading.
	–56 Rolling.
(6)	
23–62 Base course—spreading sand and chips.	–61 Spreading materials.
	–62 Spreading screenings, sand, and chips.
(7)	
27–36 Top course—loading and hauling.	–63 Sprinkling.
	27 Top course:
(8)	
27–34 Top course—laying.	–31 Hauling.
	–32 Heating bituminous materials.
	–35 Loading.
	–56 Rolling.
(9)	
27–60 Top course—spreading bitumen.	–60 Spreading bitumen.
	–61 Spreading materials.
(10)	
27–24 Top course—finishing.	–62 Spreading screenings, sand, and chips.
	23–06 Cleaning base.

The timekeeper had only ten code numbers for general use, but where detailed costs were desired in order to determine relative efficiency and to eliminate wasteful methods 28 code numbers were used.

DETAIL OF COST ACCOUNTS AND NECESSARY CODES.

The detail in which costs are recorded must be left to the judgment of the supervisor or engineer in charge of the work. Unnecessary refinements are not desirable, as they only increase the work of those who used the data. On the other hand, divisions that are too general and inclusive will prevent the study of results for the purpose of promoting efficiency. The use or final disposition of the data is the factor which should determine the necessary details.

For example, let it be assumed that a county engineer or superintendent desires costs on a brick road for the purpose of making reports on expenditures to the board of highway supervisors. In this case summary costs of completed parts probably would meet the requirements. The divisions would logically be the main divisions of the road and the costs would be collected by these divisions.

This would provide the simplest division and consequently the simplest code, which for the case assumed would be as follows:

COST DIVISIONS.	Code.
Right of way	09
Grade and roadside (or grading)	19
Roadway (or surfacing)	29
Ditches and drains	39
Bridges and culverts	49
Supplementary parts	59
Engineering and supervision	69
Administration	99

The first and the last two of these divisions would be compiled from office data so that the cost keeper would be concerned with only five divisions of field data.

The next advanced step that would be desirable in many cases would be the cost of major operations divided by road parts. This would give information suitable for the comparison of results with work of a like character or with unit prices or estimates.

COST DIVISIONS.

Road part.	*Operation*	*Code.*
Right of way:		
Plans and surveys	General	01–26
Real estate		02–
Miscellaneous		09–
Grade and roadside:		
Miscellaneous	Clearing and grubbing	19–08
Miscellaneous	Excavation, common	19–17
Roadway:		
Subgrade	Shaping	20–59
Base course	Laying	23–34
Top course	Laying	27–34
Ditches and drains:		
Paved gutter	Excavating, common	31–17
Paved gutter	Laying	31–34
Tile drains	Laying	33–34
Catch basins	General	33–26
Bridges and culverts:		
Foundations	Excavating, common	40–17
Foundations	Piling driving	40–45
Foundations	General	40–26
Abutments	General	41–26
Superstructures	General	43–26
Miscellaneous		49–
Supplementary parts:		
Signs and sign posts	General	50–26
Guard rails	General	52–26
Curbs	General	53–26
Miscellaneous		59–

COST DIVISIONS—Continued.

Road part.	*Operation.*	*Code.*
Engineering and supervision:		
Supervisory engineering	General	67–26
Inspection	General	68–26
Miscellaneous		69–
Administration:		
Engineering, departmental		97–
Miscellaneous		99–

For the purpose of obtaining costs in more detail than is given in the foregoing, both the class and operation codes are susceptible of further divisions. In the following, divisions are made of the example chosen which are as complete as will generally be practical to use for highway cost keeping except in those cases where efficiency studies are desired.

COST DIVISIONS.

Road part.	*Operation.*	*Code.*
Right of way:		
Preliminaries		00–
Right-of-way surveys	General	01–26
Right-of-way plans	General	02–26
Real estate		03–
Damages		04–
Miscellaneous		09–
Grade and roadside:		
Cuts and embankments	Excavating, common	10–17
Cuts and embankments	Excavating, borrow	10–16
Cuts and embankments	Drilling	10–14
Cuts and embankments	Blasting	10–03
Cuts and embankments	Loading	10–35
Cuts and embankments	Hauling	10–31
Cuts and embankments	Wasting materials	10–69
Cuts and embankments	Rolling	10–56
Shoulders	Rolling	11–56
Shoulders	Shaping	11–59
Berms and slopes	Trimming	12–66
Berms and slopes	Planting	12–48
Miscellaneous	Clearing	19–07
Miscellaneous	Grubbing	19–28
Miscellaneous	Blasting	19–03
Roadway:		
Subgrade	Shaping	20–59
Subgrade	Sprinkling	20–63
Subgrade	Rolling	20–56
Base course	Loading and hauling	22–36
Base course	Forming	22–25
Base course	Mixing	22–38
Base course	Placing	22–46
Base course	Shaping	22–59
Cushion course	General	26–26
Top course	Loading and hauling	27–36

COST DIVISIONS—Continued.

Road part.	*Operation.*	*Code.*
Roadway—Continued.		
Top course	Laying (brick)	27–34
Top course	Rolling (brick)	27–56
Top course	Grouting	27–27
Top course	Curing concrete	27–11
Miscellaneous	Cleaning	29–06
Ditches and drains:		
Ditches and gutters	Excavating, common	30–17
Ditches and gutters paved	Forming	31–25
Ditches and gutters paved	Loading and hauling	31–36
Ditches and gutters paved	Mixing and placing	31–39
Ditches and gutters paved	Finishing	31–24
Ditches and gutters paved	Curing concrete	31–11
Tile drains	Excavating, common	33–17
Tile drains	Laying	33–34
Tile drains	Loading and hauling	33–36
Tile drains	Tamping	33–65
Tile drains	Back filling	33–01
Catch basins	Excavating, common	34–17
Catch basins	Loading and hauling	34–36
Catch basins	Laying (brick)	34–34
Bridges and culverts:		
Foundations	Cofferdaming	40–09
Foundations	Cribbing	40–10
Foundations	Excavating, common	40–17
Foundations	Excavating, wet	40–21
Foundations	Forming	40–25
Foundations	Loading and hauling	40–
Foundations	Pumping	40–51
Foundations	Pile driving	40–45
Foundations	Mixing and placing (concrete)	40–39
Foundations	Back filling	41–01
Abutments	Loading and hauling	41–36
Abutments	Laying (masonry)	41–34
Abutments	Pumping	41–51
Abutments	Quarrying (masonry)	41–52
Piers and bents	(Same operations as abutments)	42–
Superstructures	Blacksmithing	43–02
Superstructures	Building false work	43–05
Superstructures	Curing concrete	43–11
Superstructures	Finishing	43–24
Superstructures	Forming	43–25
Superstructures	Loading and hauling	43–36
Superstructures	Mixing and placing (concrete)	43–39
Superstructures	Placing steel	43–47
Box culverts	Excavating, common	44–17
Box culverts	Loading and hauling	44–36
Box culverts	Forming	44–25
Box culverts	Mixing and placing	44–39
Box culverts	Curing concrete	44–11
Pipe culverts	Back filling	45–01

COST DIVISIONS—Continued.

Road part.	*Operation.*	*Code.*
Bridges and culverts—Continued.		
Pipe culverts	Excavating, common	45–17
Pipe culverts	Forming (headwalls)	45–25
Pipe culverts	Laying (pipe)	45–34
Pipe culverts	Loading and hauling	45–36
Pipe culverts	Mixing and placing	45–39
Miscellaneous	Cleaning	49–06
Supplementary parts:		
Signs and signposts	Building	50–04
Signs and signposts	Loading and hauling	50–36
Signs and signposts	Painting	50–43
Monuments	General	51–26
Guardrails	Building	52–04
Guardrails	Loading and hauling	52–36
Guardrails	Painting	52–43
Curbs	Back filling	53–01
Curbs	Curing concrete	53–11
Curbs	Excavating, common	53–17
Curbs	Finishing	53–24
Curbs	Forming	53–25
Curbs	Mixing and placing	53–39
Riprap and revetments	Loading and hauling	55–46
Riprap and revetments	Placing materials	55–46
Roadside treatment	Clearing	56–07
Roadside treatment	Loading and hauling	56–36
Roadside treatment	Planting	56–48
Roadside treatment	Painting	56–43
Engineering and supervision:		
Location and relocation surveys	General	60–26
Surveys for operations	General	61–26
Plans	General	62–26
Specifications and contracts	General	63–26
Estimates	General	64–26
Expense of awards	General	65–26
Office expenses engineering	General	66–26
Supervisory engineering	General	67–26
Inspection	General	68–26
Miscellaneous		69–
Plant and equipment:		
Quarries, pits, etc	General	71–26
Camp buildings and shelters	General	76–26
Storage and transportation	General	77–26
Miscellaneous	Assembling	79–00
Miscellaneous		79–
Administration:		
Engineering		97–
Miscellaneous		99–

RECORDING FORMS.

Standard forms, to record the daily expenditures of labor, materials, and plant service, should be prepared for the use of the timekeepers or foremen responsible for reports. The use of nondescript

forms or blank books should not be permitted, as such practice will result in unreliable data, often estimated at the end of the day's work, or a jumble of meaningless figures. Forms to be used for recording field data should be reduced, if possible, to pocket size for the sake of convenience. Two such forms are suggested in this bulletin, the sheets being 4¾ inches wide by 10½ inches long. It is not expected that these forms will meet all the requirements for every system, but it is believed that they are correct in principle, and with slight modifications will be found applicable for any organization doing highway work.

The forms designed and suggested herein are based upon and developed from the great number of various forms now in use in highway work throughout the United States and Canada. The same form is used for labor and equipment operations, but an additional form is necessary for materials, as it would be awkward to make out individual sheets for each kind of material. The daily summary of costs, and the periodic and total summary cost sheets are included, to show the final disposition and use of the data collected on the daily record forms. The final summaries also will fulfill the purpose of a final record of the cost of any job, and can be published for the purpose of substantiating and justifying the amounts expended.

Additional forms are necessary to record progress and character of the work by the supervising engineer, and the methods and amounts of payments made upon the work. Such forms will be treated in a subsequent bulletin.

The cost-recording forms are outlined and used as follows:

Form No. 2 (fig. 2) provides for 40 entries of men or equipment or both and their use on six classifications. The amount for each individual item can be given both in money and in total hours.

This form shows that on August 29, 1917, the foreman F. Smittie employed a gang of laborers numbered from 1 to 21; engineer, No. 4; rollers, No. 1 and No. 2; team, No. 2; guards Nos. 1 and 2; and waterboy, No. 2, on reconstruction work on the B. and W. Road, section 4.

These codes show they were employed as follows:

11–59 Grade and roadside, shoulders, shaping.
23–06 Roadway, base course, cleaning.
23–56 Roadway, base course, rolling.
23–61 Roadway, base course, spreading.
27–34 Roadway, top course, laying.
27–56 Roadway, top course, rolling.

DAILY TIME AND COST RECORD

ROAD B&W SECTION 4 8/29/17 DATE

LOCATION On Road ~~C. M.~~ R.

LABOR OR EQUIPMENT	TIME ON	TIME OFF	HRS.	RATE	TOTAL AMOUNT		CODE 11-59 HRS.	CODE 11-59 AMT.	CODE 23-06 HRS.	CODE 23-06 AMT.	CODE 27-34 HRS.	CODE 27-34 AMT.
F. Smittie	7.00	5.00			4	40						
Laborer 1	"	4.30	8½	.375	3	19					~~IIII~~ 1½	3 19
2	"	"	"	"	3	19					~~IIII~~ 1½	3 19
3	"	"	"	"	3	19					~~IIII~~ 1½	3 19
4	"	"	"	"	3	19					~~IIII~~ 1½	3 19
5	"	"	"	"	3	19					~~IIII~~ 1½	3 19
6	"	"	"	"	3	19					~~IIII~~ 1½	3 19
Sent to Rosetta 7	"	"	"	"	3	19					~~IIII~~ 1½	3 19
8	"	"	"	"	3	19					~~IIII~~ 1½	3 19
9	"	"	"	"	3	19					~~IIII~~ 1½	3 19
10	"	"	"	"	3	19					~~IIII~~ 1½	3 19
11	"	"	"	"	3	19					~~IIII~~ 1½	3 19
12	"	4.00	8	"	3	00	II	75	I	37	~~IIII~~	1 88
13	"	"	"	"	3	00					~~IIII~~ III	3 00
14	"	"	"	"	3	00					~~IIII~~ III	3 00
15	"	"	"	"	3	00	~~IIII~~	1 88	I	37	II	75
16	"	5.00	9	"	3	37					~~IIII~~ IIII	3 37
17	"	"	"	"	3	37	~~IIII~~ IIIII	3 37				
			TOTAL					6 00		74		47 09
							23-56		23-61		27-56	
Sent to Rosetta 18	"	9.00	2	.375		75			II	75		
19	"	"	"	"		75			II	75		
20	"	"	"	"		75			II	75		
21	"	"	"	"		75			II	75		
Engineer 4	"	5.00	8	.50	4	00	III	1 50			~~IIII~~	2 50
Roller 1	"	"			5	00	III	5 00				
" 2	"	"			5	00					~~IIII~~	5 00
Team 2	10.00	12.00	2		1	50	I	75			I	75
Guard 1	7.00	5.00	9		2	80						
" 2	"	"	9		2	80						
Waterboy 2	"	"	9			88	Half time to Rosetta					
			TOTAL					7 25		3 00		8 25
	Mixing Plant closed down at 4 P. M.											
	Gang sent to Rosetta											
			TOTAL		83	21						

FIG. 2.

DAILY TIME AND COST RECORD

ROAD B.&W. SECTION 4 8/29/17 DATE

LOCATION On Road ~~C.M.~~R.

LABOR OR EQUIPMENT	TIME ON	TIME OFF	HRS	RATE	TOTAL AMOUNT		CODE 19-17 HRS.	CODE 19-17 AMT.		CODE 22-61 HRS.	CODE 22-61 AMT.		CODE 23-61 HRS.	CODE 23-61 AMT.	
F. Rosetta	7.00	5.00			3	75									
Laborer 22	"	"	9	.375	3	37	卌 /	2	25	///	1	12			
23	"	"	"	"	3	37	卌 /	2	25	///	1	12			
24	"	"	"	"	3	37	卌 //	2	62	//		75			
25	"	"	"	"	3	37	卌 //	2	62	//		75			
26	"	"	"	"	3	37	卌 ////	3	37						
27	"	"	"	"	3	37	卌 ////	3	37						
28	"	"	"	"	3	37	卌 ////	3	37						
29	"	"	"	"	3	37	卌 ////	3	37						
30	"	"	"	"	3	37	卌 ////	3	37						
31	"	"	"	"	3	37	卌 ////	3	37						
From Smittie's Gang 18	9.00	"	7	"	2	62							卌 //	2	62
19	"	"	"	"	2	62							卌 //	2	62
20	"	"	"	"	2	62	///	1	12	///	1	12	/		37
21	"	"	"	"	2	62	///	1	12	///	1	12	/		37
										TOTAL	5	98			
From Carter's Gang 32	10.00	"	6	"	2	25	卌 /	2	25						
33	"	"	"	"	2	25	卌 /	2	25						
34	"	"	"	"	2	25	卌 /	2	25						
35	2.00	"	3	"	1	12	///	1	12						
From Smittie's Gang 11	4.00	"	1	"		37	/		37						
12	"	"	"	"		37	/		37						
13	"	"	"	"		37	/		37						
14	"	"	"	"		37	/		37						
15	"	"	"	"		37	/		37						
1	4.30	"	½	"		18	½		18						
2	"	"	"	"		18	½		18						
3	"	"	"	"		18	½		18						
4	"	"	"	"		18	½		18						
5	"	"	"	"		18	½		18						
6	"	"	"	"		18	½		18						
7	"	"	"	"		18	½		18						
8	"	"	"	"		18	½		18						
9	"	"	"	"		18	½		18						
10	"	"	"	"		18	½		18	22-56					
Engineer 2			6	.666	4	00	卌	3	33	/		67			
Roller 3			6	.833	5	00	卌	4	17	/		83			
										TOTAL	1	50			
Waterboy 2						87	Half time with Smittie								
			TOTAL		69	32		51	22					5	98

FIG. 3.

DAILY TIME AND COST RECORD

ROAD Route 2. SECTION A 8/24/17 DATE

LOCATION On Road C. ~~M. R.~~

LABOR OR EQUIPMENT	TIME ON	TIME OFF	HRS	RATE	TOTAL AMOUNT	CODE 11-59 HRS.	CODE 11-59 AMT.	CODE 20-59 HRS.	CODE 20-59 AMT.	CODE HRS.	CODE AMT.
A8	7.00	6.00	10	.625	6 25						
Laborer 174	"	8.30	1½	.375	55	1½	55	Fired			
187	9.30	2.30	4	"	1 50	IIII	1 50	Fired			
188	"	"	4	"	1 50	IIII	1 50	Sent to Tool House			
189	"	6.00	7½	"	2 80			IIII 11½	2 80		
197	"	2.30	4	"	1 50	IIII	1 50	Sent to Tool House			
199	"	6.00	7½	"	2 80			IIII 11½	2 80		
408	7.00	"	10	"	3 75			IIII IIII	3 75		
414	8.00	"	9	"	3 37	IIII IIII	3 37				
431	7.00	"	10	"	3 75			IIII IIII	3 75		
432	"	"	10	"	3 75			IIII IIII	3 75		
437	11.00	"	6	"	2 25	IIII I	2 25				
439	7.00	"	10	"	3 75			IIII IIII	3 75		
440	"	"	10	"	3 75			IIII IIII	3 75		
448	"	"	10	"	3 75	IIII IIII	3 75				
454	"	"	10	"	3 75	IIII IIII	3 75				
465	"	"	10	"	3 75	IIII I	2 25	IIII	1 50		
469	"	"	10	"	3 75	IIII IIII	3 75				
470	"	"	10	"	3 75	IIII	1 87	IIII	1 88		
475	"	"	10	"	3 75	IIII IIII	3 75				
477	"	8.30	1½	"	55	1½	55	Sent to Steam Shovel 2			
478	"	6.00	10	"	3 75			IIII IIII	3 75		
479	"	"	10	"	3 75	IIII IIII	3 75				
484	"	8.30	1½	"	55	1½	55	Sent to Steam Shovel 2			
485	"	"	1½	"	55	1½	55				
486	"	"	1½	"	55	1½	55				
487	"	9.30	2½	"	93	11½	93	Fired			
495	"	8.30	1½	"	55	1½	55	Sent to Steam Shovel 2			
500	"	4.00	8	"	3 00			IIII III	3 00		
501	"	8.30	1½	"	55	1½	55	Sent to Steam Shovel 2			
506	"	6.00	10	"	3 75	Carrying Water					
532	"	"	10	"	3 75	IIII IIII	3 75				
568	11.00	"	6	"	2 25	IIII I	2 25				
599	"	12.00	1	"	37	I	37	Sent to Tool House			
195	"	2.30	1½	"	55			1½	55	Sent to Tool House	
Team 21	7.00	12.00	5	.80	4 00			IIII	4 00		
" 22	"	"	5	"	4 00			IIII	4 00		
Grader	"	"	5	.50	2 50			IIII	2 50		
			TOTAL		99 67	44	14	45	53		

FIG. 4.

ROAD Ashland-Lexington
SECTION Cemetery Bridge

DAILY RECORD OF MATERIALS AND SUPPLIES

DATE Sept. 19, 1910

B. Messing FOREMAN
C. ~~M.R.~~

KIND	UNIT	RATE	CODES, UNITS, AND AMOUNTS																	
			43-39			41-39			43-25			43-47								
			UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT	
Cement	Bag	.47	150	70	50	10	4	70												
Lumber	M	30.00							1.2	36	00									
Nails	lb.	.035							20		70									
Wire	lb.	.035							10		35	8		28						
Gasoline	Gal.	.20	5	1	00	1		20												
Sand	C.Y.	.60	22	13	20	2	1	20												
Steel	lb.	.03										7800	234	00						
Oil					10															
TOTAL AMOUNTS				84	80		6	10		37	05		234	28						
WHERE USED			West Span			East Abutment			West Span			3 West Spans								

FIG. 5.

Notes on the sheet show that four laborers were transferred to foreman Rosetta at 9 a. m. and a large part of the crew between 4 and 4.30 p. m.

The daily record of foreman Rosetta's crew (fig. 3) shows on the same road a crew of 33 laborers, a water boy, roller, and engineer on classifications—

19–17 Grade and roadside, miscellaneous, excavating, common.
22–56 Roadway, sub-base course, rolling.
22–61 Roadway, sub-base course, spreading.
23–61 Roadway, base course, spreading.

Laborers were received three times during the day from foreman Smittie and once from foreman Carter.

In figure 4 is shown the work of a large crew, but on only two operations. A number of changes in the crew will be observed. Only 15 men out of a total of 36 employed worked the full day with foreman A8.

MATERIAL AND SUPPLIES.

The form for materials and supplies (fig. 5) is the same size as that for labor and equipment and may be carried by the timekeeper or foreman in the same book or binder with the other form. The material form is for one day only and 12 different materials may be recorded on a single sheet. The sheet shows distribution as follows:

FOR OPERATION 43–39, MIXING AND PLACING SUPERSTRUCTURE.

150 bags cement, at $0.47	$70.50
5 gallons gasoline, at $0.20	1.00
22 cubic yards sand, at $0.60	13.20
Oil	.10
Total for operation (used on west span)	84.80

FOR OPERATION 41–39, MIXING AND PLACING ABUTMENT.

10 bags cement, at $0.47	$4.70
1 gallon gasoline, at $0.20	.20
2 cubic yards sand, at $0.60	1.20
Total for operation (used on east abutment)	6.10

FOR OPERATION 43–25, FORMING SUPERSTRUCTURE.

1,200 feet b. m. lumber, at $0.03	$36.00
20 pounds nails, at $0.035	.70
10 pounds wire, at $0.035	.35
Total for operation (used on west span)	37.05

FOR OPERATION 43–47, SUPERSTRUCTURE, PLACING STEEL.

8 pounds wire, at $0.035	$0.28
7,800 pounds steel, at $0.03	234.00
Total for operation (used on 3 west spans)	234.28

DAILY REPORT OF COSTS.

When the records of the amount of labor, the service of equipment, and the expenditures of materials have been completed the data for arriving at unit costs are at hand. For convenience in bringing together these three elements of cost, a form has been drawn up called the "Daily report of costs." This is not for field use and is 8½ inches wide and 13½ inches long. The unit costs are arrived at by setting down against the code number all labor equipment and material charges in detail. These are added together and the sum is divided by the units of work completed as estimated by the foreman. The units completed are checked against the engineer's monthly estimate and should not show a very great discrepancy, say not over 5 per cent at the outside.

Sample labor and equipment and materials forms for work of constructing a field stone base course of a road and the daily report of costs form filled out from these are shown on pages 33, 34 and 35.

These three forms compose the entire set needed to record the field operations and compute unit costs of such operations.

IMMEDIATE USE OF COST DATA.

When the daily reports of costs reach the official responsible for the work he can readily prepare a graph (fig. 6) showing both the estimated unit cost and the actual daily unit cost in convenient form. Any wide divergence between the estimated and actual costs is apparent at once and can be investigated. The horizontal axis of the graph in this case is divided to show the days of the month. The vertical axis is divided to show the unit cost of the work. Some such chart will show effect of conditions upon the work.

FINAL DISPOSITION OF COST DATA.

It has been pointed out that the objects of a cost-keeping system are two. First, to show the efficiency of performance and facilitate the reduction of costs, and, second, to supply data which may be used for the intelligent estimating of future improvements and to furnish materials for published reports.

Highway work obviously is a public improvement paid for entirely from funds derived from the public revenue. Ultimately, then, the taxpayer pays for all of this improvement and is entitled to a full and detailed account of how this money was expended. Again, public records of this kind are all that remain to be used for the comparing of the efficiency of one administration with that of another. It would appear, therefore, to be a step in the direction of good judgment for all those in charge of public improvements to adopt

some simple system of cost keeping such as is outlined herein, which could be used both as an aid to present efficiency and as a complete report of the ability of the officials in charge to get the most for the public funds.

For the purpose of presenting in concise form the costs and also to show the progress being made during the period of construction the form shown on page 36, "Report of Progress and Cost," is suggested. The costs which comprise this report may be compiled from daily reports. Such compilation may be made from day to day on a form similar to the one shown on page 37. Where the cost data are derived in greater detail than is provided for by this form, the "Cost Compilation Form" may be arranged in several sheets.

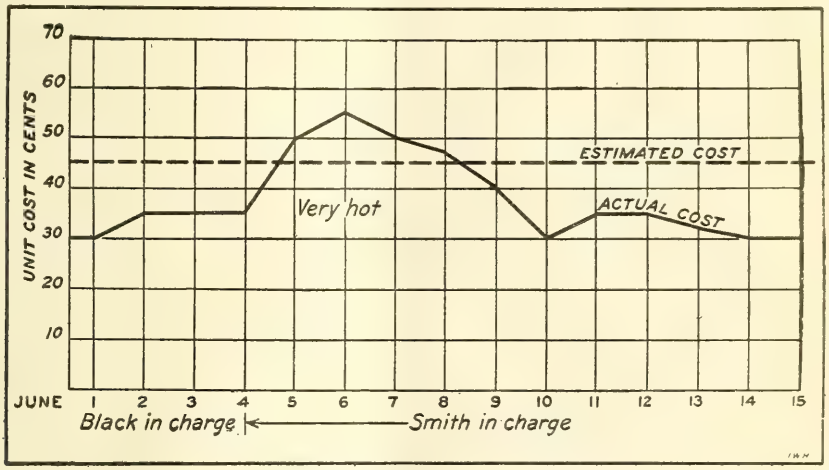

FIG. 6.—Graph showing estimated and actual costs.

The "Final Cost Summary" shown on page 38 is for the purpose of bringing together all expenditures involved and all units of work done, and to show unit costs, total cost of parts, per cent of cost by parts, and total cost of the entire improvement.

The daily time and cost record of foreman Waugh's crew (fig. 7) shows:

86 hours labor on code 23–34 (laying base course)	$35.44
14 hours labor on code 11–59 (shaping shoulders)	5.77
14 hours labor on code 20–59 (shaping sub-grade)	5.77
28 hours labor on code 23–12 (crushing base course)	11.52
10 hours labor, 1 hour team hire on code 23–56 (rolling base course)	15.05
115 hours team hire on code 23–31 (hauling base course)	92.00

The daily record of materials and supplies (fig. 8) shows:

Expenditures for 87 cubic yards fired stone on code 23–34 (laying base course)	$21.75
One quarter ton coal on code 23–56 (rolling base course)	1.00

These data are combined and arranged on the daily report of costs form (fig. 9) so as to make possible the ready determination of unit costs. In this case no indirect labor cost is charged to equipment. Teams were used only for hauling and were required to make a certain number of trips per day.

The amount of work done was reported to the superintendent by the engineer in charge of this division of the work.

DAILY TIME AND COST RECORD

ROAD Route 2 SECTION A 8/25/17 DATE

LOCATION 40+75 to 45+00 C. ~~M.R.~~

LABOR OR EQUIPMENT	TIME ON	TIME OFF	HRS	RATE	TOTAL AMOUNT		CODE 23-34 HRS	CODE 23-34 AMT.		CODE 20-59 HRS.	CODE 20-59 AMT.		CODE 23-12 HRS.	CODE 23-12 AMT.	
F. Waugh	7.00	6.00	10	.75	7	50									
Laborer 592	"	"	"	.412	4	12	~~IIII~~ ~~IIII~~	4	12						
601	"	"	"	"	4	12	~~IIII~~ I	2	47				IIII	1	65
610	"	"	"	"	4	12	~~IIII~~	2	06				~~IIII~~	2	06
590	"	"	"	"	4	12	~~IIII~~	2	06				~~IIII~~	2	06
589	"	"	"	"	4	12	III	1	24	III	1	24	IIII	1	64
533	"	"	"	"	4	12	~~IIII~~	2	06				~~IIII~~	2	06
546	9.00	"	8	"	3	30	~~IIII~~	2	06	III	1	24			
481	10.00	"	7	"	2	88	~~IIII~~ I	2	47	I		41			
474	7.00	"	10	"	4	12	~~IIII~~ ~~IIII~~	4	12						
473	"	"	"	"	4	12	~~IIII~~ III	3	30				II		82
467	"	"	"	"	4	12	~~IIII~~ III	3	30				II		82
466	"	"	"	"	4	12	~~IIII~~ III	3	30	II		82			
422	10.00	"	7	"	2	88	~~IIII~~ II	2	88						
					TOTAL		86	35	44						
							11-59								
420	7.00	6.00	10	.412	4	12	~~IIII~~ I	2	47	III	1	24	I		41
425	"	"	"	"	4	12	~~IIII~~ III	3	30	II		82			
					TOTAL		14	5	77	14	5	77	28	11	52
							23-56			23-31					
Team 9	7.00	6.00	10	.80	8	00				~~IIII~~ ~~IIII~~	8	00			
12	"	"	"	"	8	00				~~IIII~~ ~~IIII~~	8	00			
15	"	"	"	"	8	00				~~IIII~~ ~~IIII~~	8	00			
16	"	"	"	"	8	00				~~IIII~~ ~~IIII~~	8	00			
17	"	"	"	"	8	00				~~IIII~~ ~~IIII~~	8	00			
18	"	"	"	"	8	00				~~IIII~~ ~~IIII~~	8	00			
23	"	"	"	"	8	00				~~IIII~~ ~~IIII~~	8	00			
Waterboy 115	"	"	"	.275	2	75									
Engineer 169	"	"	"	.625	6	25	~~IIII~~ ~~IIII~~	6	25						
Roller 13		Day			8	00	Day	8	00						
Team 5	8.00	6.00	9	.80	7	20				~~IIII~~ IIII	7	20			
19	"	"	"	"	7	20				~~IIII~~ IIII	7	20			
21	"	"	"	"	7	20				~~IIII~~ IIII	7	20			
25	"	"	"	"	7	20				~~IIII~~ IIII	7	20			
30	"	"	"	"	7	20				~~IIII~~ IIII	7	20			
3	2.00	3.00	1	"		80	I		80						
					TOTAL		11	15	05	115	92	00			
TOTAL					175	80									

FIG. 7.

ROAD Route 2

SECTION A

DAILY RECORD OF MATERIALS AND SUPPLIES

DATE 8/25/17

F. Waugh FOREMAN

C.~~M.R.~~

KIND	UNIT	RATE	CODES, UNITS, AND AMOUNTS																					
			23-34			23-56																		
			UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT		UNITS	AMOUNT	
Fld Stone	C.Y.	.25	87	21	75																			
Coal	Ton	4.00				.25	1	00																
TOTAL AMOUNTS				21	75		1	00																
WHERE USED			43+75 to 41+50			45+00 to 41+00																		

FIG. 8.

DAILY REPORT OF COSTS

C.M.R.

ROAD Route 2 SECTION A WEATHER Clear-Warm FOREMAN F. Waugh DATE 8-25-17

CODE NUMBERS	LABOR KIND	LABOR HOURS	LABOR RATE	LABOR AMOUNT	EQUIPMENT KIND	EQUIPMENT HOURS	EQUIPMENT RATE	EQUIPMENT AMOUNT	MATERIALS & SUPPLIES KIND	UNIT	NUMBER	RATE	AMOUNT	LABOR EQUIPMENT SUPPLIES MATERIALS	UNITS OF WORK COMPLETED NUMBER	UNIT	UNIT COST	LOCATION
11-59	Labor	14	412	5 77														
	Indirect			94										6 71	300	Per foot of road	.022	43+75 to 40+70
																	.013	sq. yds. of roadway
20-59	Labor	14	412	5 77														43+75 to 40+75
	Indirect			94										6 71	533.3	sq. yds.	.013	16 ft. wide
23-12	Labor	28	412	11 52														43+75 to 41+48
	Indirect			1 89										13 41	404	sq. yds.	.033	16 ft. wide
23-34	Labor	86	412	35 44					Fld. Stone	C.Yd.	87	.25	21 75					43+75 to 41+48
	Indirect			5 80										62 99	404	sq. yds.	.156	16 ft. wide
23-31					Teams	115	.80	92 00						92 00	404	sq. yds.	.228	43+75 to 41+48
23-56	Engineer	10	.625	6 25	Team	1	.80	.80	Coal	Ton	.25	4.00	1.00					45+00 to 41+00
	Indirect			.67	Roller	day		8 00						16 72	711	sq. yds.	.024	16 ft. wide
Totals		152		74 99				100 80					22 75	198 54	Per sq. yd. riding		.467	
Indirect	Foreman	10	.75	7 50	Basis for distribution Indirect labor expenses on direct labor costs.													
	H.t. Boy	10	.275	2 75														
	Labor	152	.0674	10 25														

FIG. 9.

REPORT OF PROGRESS AND COST.

Road No. 144—Sections A. Construction. Period from Mar. 1 to 15, 1917.

Code Nos.	Classification.	Unit.	For this period.			Summary to date.			Completed.
			Units completed.	Total cost.	Unit cost.	Units completed.	Total cost.	Unit cost.	
	Right of way:								*Per cent.*
01-26	Plans and surveys, general						$400.00		100
02	Real estate	Acre	10	$500.00	$50.00	25	1,500.00	60.00	80
09	Miscellaneous			600.00			1,200.00		85
	Grade and roadside:								
19-08	Clearing and grubbing	Acre	4	160.00	40.00	19	950.00	50.00	57
19-17	Miscellaneous, excavation, common	Cubic yard	500	150.00	.30	2,000	500.00	.25	50
	Roadway:								
20-59	Subgrade, shaping	Square yard	1,200	36.00	.03	16,000	64.00	.04	10
23-34	Base course, laying	do	1,000	900.00	.90	16,000	14,400.00	.90	10
27-34	Top course, laying	do	1,600	960.00	.60	1,600	960.00	.40	1
	Ditches and drains:								
31-17	Paved gutter, excavation, common	Linear foot	400	8.00	.02	1,000	30.00	.03	6
31-34	Paved gutter, laying	do	200	80.00	.40	800	320.00	.40	5
33-34	Tile drains, laying	do	50	15.00	.30	50	15.00	.30	2
33-26	Catch basins, general		2	40.00	20.00	3	60.00	22.00	25
	Bridges and culverts:								
40-17	Foundations, excavation, common	Cubic yard	2,000	1,600.00	.80	3,000	2,400.00	.80	80
40-45	Foundations, piling, driving	Linear foot	1,200	480.00	.40	2,000	1,000.00	.50	45
40-26	Foundations, general	Cubic yards	125	1,457.50	11.50	125	1,457.50	11.50	80
41-26	Abutments, general	do	400	3,600.00	9.00	400	3,600.00	9.00	60
43-26	Superstructures, general	do	120	1,920.00	16.00	120	1,920.00	16.00	
49-26	Bridges and corrugated pipe culverts, general	Linear foot	150	300.00	2.00	150	300.00	2.00	10
	Supplementary parts:								
50-26	Signs and sign posts, general		75	150.00	2.00	100	210.00	2.10	50
52-26	Guardrails, general	Linear foot	100	100.00	1.00	300	300.00	1.00	40
53-26	Curbs, general	do	1,000	200.00	.20	2,000	450.00	.22½	20
59-26	Monuments, general		10	30.00	3.00	10	30.00	3.00	40
	Engineering and supervision:								
67-26	Supervisory engineering, general			60.00			300.00		
68-26	Inspection, general			100.00			500.00		
69-	Miscellaneous			10.00			15.00		
	Total expenditures			13,456.00			32,887.50		

COST COMPILATION.

Road No. .....
Sections.....
Work begun.....
Completed.....

.....Superintendent.

Construction.
Maintenance.
Reconstruction.

Date.		Source of Item.	Right of way.			Grade and Roadside.		Roadway.			Ditches and drains.				Bridges and culverts.						Supplementary parts.				Engineering and supervision.			Administration.		Totals.
Mo.	Day.		01–26	02–	09–	19–08	19–17	20–59	23–34	27–34	31–17	31–34	33–34	33–26	40–17	40–45	40–26	41–26	43–26	49–	50–26	52–26	53–26	59–26	67–26	68–26	69–	97–	99–	

This form will be found very useful for the purpose of compiling costs. The data on the "Daily Reports of Costs" may be recorded each day and at any period the total costs by items may be obtained readily by adding the cost items already collected.

FINAL COST SUMMARY.

Road .....
Sections .....
.....
Sup't.

Cost of Construction .....
Date of Acceptance .....

[Items including cost of labor, materials, supplies, and rental of equipment.]

Road part.	Operation.	Code.	Units.	Unit cost.	Cost.	Total cost.	Percentage of whole cost.
Right of way:							
Plans and surveys	General	01-26	Acres				*Per cent.*
Real estate		02-	do				
Miscellaneous		09-	do				
Grade and roadside:							
Miscellaneous	Clearing and grubbing	19-08	do				
Miscellaneous	Excavation, common	19-17	Cu. yd				
Roadway:							
Subgrade	Shaping	20-59	Sq. yd				
Base course	Laying	23-34	do				
Top course	Laying	27-34	do				
Ditches and drains:							
Paved gutter	Excavation, common	31-17	Lin. ft				
Paved gutter	Laying	31-34	do				
Tile drains	Laying	33-34	do				
Catch basins	General	33-26	Only				
Bridges and culverts:							
Foundations	Excavation, common	40-17	Cu. yd				
Foundations	Piling, driving	40-45	Lin. ft				
Foundations	General	40-26	Cu. yd				
Abutments	General	41-26	do				
Superstructures	General	43-26					
Miscellaneous		49-					
Supplementary parts:							
Signs and sign posts	General	50-26	Lin. ft				
Guard rails	General	52-26	do				
Curbs	General	53-26	do				
Miscellaneous		59					
Engineering and supervision:							
Supervisory engineering	General	67-26					
Inspection	General	68-26					
Miscellaneous		69					
Administration:							
Engineering, departmental		97					
Miscellaneous		99					
Grand total							

DEFINITIONS OF OPERATION TERMS.

In road work it is not uncommon to find that the same operations are designated by different terms in different sections of the country. It has been thought advisable, therefore, to define briefly the processes which should be included by the cost keeper under each operation. Some of these operations will be found to overlap somewhat under certain conditions. This slight overlapping, however, seems preferable to the present ambiguity in the meaning of many of our road terms. Adherence to the following definitions will serve, therefore, to make such cost data as are collected more nearly comparable, regardless of locality. The several operations are defined in terms of the processes which they include.

Assembling.—Shall include all bringing together or collecting of tools and equipment, setting up of machinery, portable shacks, and all other structures where the parts are delivered "knocked down" and require only bolting or riveting together.

Back filling.—Shall include all processes of refilling excavations or filling against the back of abutments, walls, etc.

Blacksmithing.—Shall include all processes of working or shaping metals, except riveting, and shall include also such work in repairing the metal parts of machinery and equipment.

Blasting.—Shall include all methods of rending or loosening of rock, earth, or other material with an explosive.

Building.—Shall include the making, erecting, and establishing of buildings, structures, or parts, except bridges or portable structures delivered cut to fit.

Building false work.—Shall include the building or erecting of all temporary supports and bracing necessary for the erection of structures.

Cleaning.—Shall include all removal of dirt or débris by any means from the surfaces of roadways or from ditches, drains, culverts, etc., and shall include the sweeping of all road surfaces. It shall be applied also to the operations necessary to remove deleterious matter or coatings from the surfaces of such structures as bridges, buildings, guard rails, etc.

Clearing.—Shall include the freeing of the roadway and roadside of all vegetation or incumbrances.

Clearing and grubbing.—Shall include in addition to clearing, as defined above, the removal and disposal of stumps.

Cofferdamming.—Shall include only the building of cofferdams.

Cribbing.—Shall include the building of all kinds of timber cribs to retain or sustain earth work.

Curing concrete.—Shall include the careful protection and slow drying of concrete, to prevent cracking or injury of any kind until the concrete has hardened.

Crushing.—Shall include all reducing of stone or other material to small particles by pounding or squeezing, whether the work be done by machine or hand.

Dragging.—Shall include the smoothing of a roadway surface or the shaping and partial compacting of road courses with a road drag.

Drilling.—Shall include the piercing or boring of any material, as iron or rock, with drills operated by hand or driven by power.

Drilling and blasting.—Shall include, in addition to the drilling, the loading of the holes with an explosive and the detonation of the explosive charge.

Excavating.—Shall include the grading of the roadway, ditches, and slopes, and also the hollowing out by cutting or digging of all excavations for drainage structures.

Filling ruts.—This operation needs no explanation.

Filling washouts.—This operation needs no explanation.

Finishing.—Shall include all other work necessary to complete a road or part of a roadway.

Forming.—Shall include the building of all forms for concrete work and the removal of the same.

General.—Shall include all charges impossible to allocate directly as belonging to any other operation in the table, or as a summary of operations on particular posts when desired.

Grouting.—Shall include all filling out and finishing of any work with a thin watery cement, or cement and sand mixture, as the grouting of brick pavements, etc.

Grubbing.—Shall include the removal of stumps and roots.

Guarding.—Shall include all charges for watchmen, barriers, signs, and warning lights during the period that the road is being constructed or repaired.

Harrowing.—Shall include all methods of breaking up clods of material on the road or mixing with harrows the materials of which the road is to be made. It differs from loosening.

Hauling.—Shall include the transportation of materials or equipment.

Heating.—Shall include all processes of raising the temperature of materials by the application of heat.

Laying.—Shall include the coating, spreading over, or covering any roadway course or road surface with any material, the placing in definite position of similar individual pieces of prepared material, or the constructing of a roadway course.

Loading.—Shall include the placing of any object or material in a conveyance.

Loading and hauling.—Shall include a combination of loading and hauling, both of which have been defined.

Loosening.—Shall include the breaking up of a dense, close mass, as an old road surface, into detailed particles with picks, scarifiers, or any other equipment.

Mixing.—Shall include all blending of materials into masses by stirring or turning, such as the mixing of concrete, water, aggregate, etc., but shall not include harrowing.

Mixing and placing.—Shall include, in addition to mixing, the locating of the mixed material in a desired position.

Moving.—Shall include all operations necessary for shifting or changing the position of any object. Thus it is a general term and may include a number of specific operations.

Operating.—Shall include the continuing in activity of any machinery.

Oiling.—Shall include the spraying or coating of a road surface with liquid bituminous matter.

Painting.—Shall include the covering of any object with a coating of a prepared pigment; also shall include whitewashing.

Patroling.—Shall include the continuous services of patrolmen repairing and maintaining a designated stretch of road.

Pile driving.—Shall include the placing of piles or sheathing by means of a driving hammer.

Placing.—Shall include the locating in a desired position of any object or material.

Planting.—Shall include the putting or placing of any sod, seed, shrub, or tree for growth.

Plumbing.—Shall include the preparation and placing of pipes, pumps, etc., required to deliver water to the road.

Plowing.—Shall include the loosening of any material by the use of a plow.

Pumping.—Shall include the lifting or driving of any material by pumps.

Quarrying.—Shall include the taking out of stone from an excavation or quarry.

Removing snow.—Requires no explanation.

Repairing.—Shall include all acts of returning to a sound state any road part where the work done is not extensive enough to be classified as reconstruction.

Riveting.—Shall include the uniting of two or more pieces with rivets and the heading of the rivets.

Rolling.—Shall include all compressing of roadway or surface material with a hand, horse, or power roller.

Scarifying.—Shall include the loosening or stirring up of the surface or the breaking of a bond of the road. This is almost synonymous with loosening.

Screening.—Shall include the removal of all undesirable particles from any material by passing it through or over a screen, or both.

Shaping.—Shall include all processes of bringing road parts as subgrade, shoulders and courses to a regular form of section.

Spreading.—Shall include the scattering or distributing of any materials over a large surface in order to form a coating or layer of uniform depth.

Sprinkling.—Shall include the distribution of water, in a fine coat over a surface.

Stripping.—Shall include all removing or taking off the cover or burden from gravel pits or quarries.

Trimming.—Shall include the cutting off of small quantities of excavation to make the roadway or roadside conform to a regular outline or section.

Washing.—Shall include the removal of any undesirable matter from a material by use of water.

Washing and screening.—Shall include, in addition to washing, the processes explained under screening.

Wasting material.—Shall include all depositing on a dump or spoil bank of excavated materials that can not be used in embankment.

Waterproofing.—Shall include all protecting from water of concrete walls, etc., by the use of bituminous or any other material.

Working on joints.—Shall include all the labor made necessary by the introduction of expansion or contraction joints, natural or artificial, and also the openings between regular sets, as the joints in a brick roadway.

Wrecking.—Shall include the tearing down or destroying of any structures.

APPENDIX.

TABLES USEFUL IN DETERMINING COSTS AND PREPARING ESTIMATES.

TABLE 1.—*Some of the more common units of measurement used in collecting cost data on highway work.*

Aggregates, stone, sand, gravel, etc.....Cubic yard or ton of 2,000 pounds.
Bituminous materials.....Gallon, or ton of 2,000 pounds.
Blocks: Brick, stone, asphalt, wood, etc.....Thousand.
Bridges and culverts:
  Metal.....Pound, or ton of 2,000 pounds.
  Painting, cleaning, erecting, or razing, often by.Linear foot.
  Concrete, masonry, etc.....Cubic yard.
Cement, Portland, barrel of 4 bags.....Bag, 94 pounds.
Clearing, clearing and grubbing, grubbing.....Acre.
Concrete.....Cubic foot or cubic yard.
Curbs, curb and gutter, gutters.....Linear foot.
Culvert pipe—Metal, vitrified, concrete, wood, etc.Linear foot.
Ditches, drains, drain tile.....Linear foot.
Excavation, embankment, and earthwork in general.....Cubic yard.
Fences, guard rails, etc.....Linear foot.
Lumber.....Thousand board feet.
Pipe—Drain, sewer, pipe railing, etc.....Linear foot.
Piling.....Linear foot.
Roadway: Courses, surfaces, subgrade, etc; construction, reconstruction, and maintenance operations.....Usually square yard.
Steel and iron—Shapes, rods, pipes, mesh, etc....Pound, or ton of 2,000 pounds.
Unit materials, structures, or parts, as blocks, inlet covers, monuments, sign posts, etc.....Single unit or thousand.

TABLE 2.—*Cubic yards of macadam compacted in place per 100 feet of road for various widths.*[1]

Width.	Depth.							
	2 inches.	2½ inches.	3 inches.	3½ inches.	4 inches.	5 inches.	6 inches.	7 inches.
Feet.	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*
10	6.17	7.71	9.26	10.80	12.34	15.43	18.52	21.61
12	7.41	9.26	11.11	12.96	14.82	18.52	22.22	25.93
14	8.64	10.80	12.96	15.12	17.28	21.61	25.92	30.25
15	9.26	11.58	13.89	16.20	18.52	23.16	27.78	32.41
16	9.88	12.35	14.81	17.28	19.76	24.70	29.63	34.57
18	11.11	13.90	16.67	19.44	22.22	27.79	33.34	38.89
20	12.35	15.44	18.52	21.60	24.70	30.87	37.04	48.21
22	13.58	16.98	20.37	23.76	27.16	33.96	40.74	47.53

[1] Harger and Bonney.

TABLE 3.—*Gallons of bituminous material needed per 100 feet of varying width.*[1]

Width.	Gallons per square yard.				
	0.5	1.0	1.5	2.0	2.5
Feet.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
8	44.44	88.89	133.33	177.78	222.22
10	55.56	111.11	166.67	222.22	277.78
12	66.67	133.33	200.00	266.67	333.33
14	77.78	155.56	233.33	311.11	388.89
15	83.33	166.67	250.00	333.33	416.67
16	88.89	177.78	266.67	355.56	444.44
18	100.00	200.00	300.00	400.00	500.00
20	111.11	222.22	333.33	444.44	555.56
22	122.22	244.44	366.67	488.89	611.11
30	166.67	333.33	500.00	666.66	833.33
40	222.22	444.44	666.67	888.88	1,111.10

[1] Adapted from Harger and Bonney.

NOTE.—Bituminous road materials usually average from 45 to 50 gallons to the barrel.

TABLE 4.—*Feet in decimals of a mile.*[1]

Feet.	Miles.	Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
1	0.00019	40	0.00758	600	0.11364	8,000	1.51515
2	.00038	50	.00947	700	.13258	9,000	1.70455
3	.00057	60	.01136	800	.15152	10,000	1.8939
4	.00076	70	.01326	900	.17046	20,000	3.7879
5	.00095	80	.01515	1,000	.18939	30,000	5.6818
6	.00114	90	.01705	2,000	.37879	40,000	7.5758
7	.00132	100	.01894	3,000	.56818	50,000	9.4697
8	.00152	200	.03788	4,000	.75758	60,000	11.3636
9	.00171	300	.05682	5,000	.94697	70,000	13.2576
10	.00189	400	.07576	6,000	1.13636	80,000	15.1515
20	.00379	500	.09470	7,000	1.32576	90,000	17.0455
30	.00568						

[1] Harger and Bonney.

TABLE 5.—*Number of square yards and acres per 100 feet and per mile for various widths.*

Width.	Square yards.		Acres.		Width.	Square yards.		Acres.	
	Per 100 feet.	Per mile.	Per 100 feet.	per mile.		Per 100 feet.	Per mile.	Per 100 feet.	Per mile.
Feet.					*Feet.*				
1	11.111	586.667	0.00230	0.121	26	288.889	15,253.3	0.05969	3.152
2	22.222	1,173.334	.00459	.242	28	311.111	16,426.7	.06428	3.394
3	33.333	1,760.001	.00689	.364	30	333.333	17,600.0	.06887	3.636
4	44.444	2,346.668	.00918	.485	32	355.556	18,773.3	.07346	3.879
5	55.556	2,933.335	.01148	.606	34	377.778	19,946.7	.07805	4.121
6	66.667	3,520.002	.01377	.727	36	400.000	21,120.0	.08265	4.364
7	77.778	4,106.669	.01607	.848	38	422.222	22,293.3	.08724	4.606
8	88.889	4,693.3	.01837	.970	40	444.444	23,466.7	.09183	4.848
9	100.000	5,280.0	.02066	1.091	42	466.667	24,640.0	.09642	5.090
10	111.111	5,866.6	.02296	1.212	44	488.889	25,813.3	.10101	5.333
12	133.333	7,040.0	.02755	1.454	46	511.111	26,986.7	.10560	5.575
14	155.556	8,213.3	.03214	1.697	48	533.333	28,160.0	.11019	5.818
15	166.667	8,800.0	.03444	1.818	50	555.556	29,333.4	.11478	6.061
16	177.778	9,386.7	.03673	1.939	60	666.667	35,200.0	.13774	7.273
18	200.000	10,560.0	.04132	2.182	70	777.778	41,066.7	.16070	8.485
20	222.222	11,734.0	.04591	2.424	80	888.889	46,933.3	.18366	9.697
22	244.444	12,906.7	.05051	2.666	90	1,000.000	52,800.0	.20661	10.909
24	266.667	14,080.0	.05510	2.909	100	1,111.111	58,666.7	.22957	12.121

TABLE 6.—*Cubical contents of various vehicles commonly used for transporting material.*

[Loose measure.]

	Cubic feet.
Cart:	
One horse (regular size) 3 by 4 feet by 9 inches	9
One horse (large) 3 by 5½ feet by 12 inches	16.5
Concrete, push	5
Fresno scraper	9–14
Scraper drag:	
No. 1	7
No. 2	4–5
Scraper wheel:	
No. 1	9–10
No. 2	12–13
No. 2½	14
No. 3	16–17
Wagon:	
Slat-bottom dump, 3 by 9 feet by 12 inches	27
Dump bottom, 3 by 9 feet by 24 inches	54
Wheel-barrows:	
Regular size	2
Large	3

TABLE 7.—*Quantities required for 1 cubic yard of concrete for various mixtures.*

[Based on one barrel of cement being equal to 376 pounds, or 4 bags of 94 pounds each, and a barrel equal to 3.8 cubic feet and using stone, 45 per cent voids.]

Mixture.			Material necessary for 1 cubic yard of concrete.					
			Cement.		Sand.		Stone.	
Cement. C.	Sand, S.	Stone, G.	Barrels.	Bags.	Cubic yards.	Cubic feet.	Cubic yards.	Cubic feet.
1	2	4	1.57	6¼	0.44	11¾	0.88	23¾
1	2½	5	1.30	3¼	.46	12⅔	.92	24⅔
1	3	6	1.11	4½	.47	12¾	.94	25

A very handy formula for finding the amount of material to make 1 cubic yard of concrete is:

$$\text{The barrels of cement in 1 cubic yard} = \frac{11}{C+S+G}$$

Example:

Barrels of cement to make a cubic yard of 1:2½:5 mixture =

$$\frac{11}{1+2\frac{1}{2}+5} = 1.3 \text{ barrels.}$$

To find the cubic yards of sand: Multiply barrels of cement by proportional part of sand and the product by 0.141. Example: $1.3 \times 2\frac{1}{2} \times 0.141 = 0.458$ cubic yards of sand. To find the cubic yards of stone, multiply the barrels of cement by the proportional part of stone and the product by 0.141. Example: $1.3 \times 5 \times 0.141 = 0.916$.

TABLE 8.—*Cubic yards for sum of end areas.*

[Length of prism 100 feet.]

Sum of end areas.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	.....	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.5	1.7
1	1.9	2.0	2.2	2.4	2.6	2.8	3.0	3.1	3.3	3.5
2	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.2	5.4
3	5.6	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.0	7.2
4	7.4	7.6	7.8	8.0	8.1	8.3	8.5	8.7	8.9	9.1
5	9.3	9.4	9.6	9.8	10.0	10.2	10.4	10.6	10.7	10.9
6	11.1	11.3	11.5	11.7	11.9	12.0	12.2	12.4	12.6	12.8
7	13.0	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.4	14.6
8	14.8	15.0	15.2	15.4	15.6	15.7	15.9	16.1	16.3	16.5
9	16.7	16.9	17.0	17.2	17.4	17.6	17.8	18.0	18.1	18.3
10	18.5	18.7	18.9	19.1	19.3	19.4	19.6	19.8	20.0	20.2
11	20.4	20.6	20.7	20.9	21.1	21.3	21.5	21.7	21.9	22.0
12	22.2	22.4	22.6	22.8	23.0	23.1	23.3	23.5	23.7	23.9
13	24.1	24.3	24.4	24.6	24.8	25.0	25.2	25.4	25.6	25.7
14	25.9	26.1	26.3	26.5	26.7	26.8	27.0	27.2	27.4	27.6
15	27.8	28.0	28.1	28.3	28.5	28.7	28.9	29.1	29.3	29.4
16	29.6	29.8	30.0	30.2	30.4	30.6	30.7	30.9	31.1	31.3
17	31.5	31.7	31.9	32.0	32.2	32.4	32.6	32.8	33.0	33.1
18	33.3	33.5	33.7	33.9	34.1	34.3	34.4	34.6	34.8	35.0
19	35.2	35.4	35.6	35.7	35.9	36.1	36.3	36.5	36.7	36.9
20	37.0	37.2	37.4	37.6	37.8	38.0	38.1	38.3	38.5	38.7
21	38.9	39.1	39.3	39.4	39.6	39.8	40.0	40.2	40.4	40.6
22	40.7	40.9	41.1	41.3	41.5	41.7	41.9	42.0	42.2	42.4
23	42.6	42.8	43.0	43.1	43.3	43.5	43.7	43.9	44.1	44.3
24	44.4	44.6	44.8	45.0	45.2	45.4	45.6	45.7	45.9	46.1
25	46.3	46.5	46.7	46.9	47.0	47.2	47.4	47.6	47.8	48.0
26	48.1	48.3	48.5	48.7	48.9	49.1	49.3	49.4	49.6	49.8
27	50.0	50.2	50.4	50.6	50.7	50.9	51.1	51.3	51.5	51.7
28	51.9	52.0	52.2	52.4	52.6	52.8	53.0	53.1	53.3	53.5
29	53.7	53.9	54.1	54.3	54.4	54.6	54.8	55.0	55.2	55.4
30	55.6	55.7	55.9	56.1	56.3	56.5	56.7	56.9	57.0	57.2
31	57.4	57.6	57.8	58.0	58.1	58.3	58.5	58.7	58.9	59.1
32	59.3	59.4	59.6	59.8	60.0	60.2	60.4	60.6	60.7	60.9
33	61.1	61.3	61.5	61.7	61.9	62.0	62.2	62.4	62.6	62.8
34	63.0	63.1	63.3	63.5	63.7	63.9	64.1	64.3	64.4	64.6
35	64.8	65.0	65.2	65.4	65.6	65.7	65.9	66.1	66.3	66.5
36	66.7	66.9	67.0	67.2	67.4	67.6	67.8	68.0	68.1	68.3
37	68.5	68.7	68.9	69.1	69.3	69.4	69.6	69.8	70.0	70.2
38	70.4	70.6	70.7	70.9	71.1	71.3	71.5	71.7	71.9	72.0
39	72.2	72.4	72.6	72.8	73.0	73.1	73.3	73.5	73.7	73.9
40	74.1	74.3	74.4	74.6	74.8	75.0	75.2	75.4	75.6	75.7
41	75.9	76.1	76.3	76.5	76.7	76.9	77.0	77.2	77.4	77.6
42	77.8	78.0	78.1	78.3	78.5	78.7	78.9	79.1	79.3	79.4
43	79.6	79.8	80.0	80.2	80.4	80.6	80.7	80.9	81.1	81.3
44	81.5	81.7	81.9	82.0	82.2	82.4	82.6	82.8	83.0	83.1
45	83.3	83.5	83.7	83.9	84.1	84.3	84.4	84.6	84.8	85.0
46	85.2	85.4	85.6	85.7	85.9	86.1	86.3	86.5	86.7	86.9
47	87.0	87.2	87.4	87.6	87.8	88.0	88.1	88.3	88.5	88.7
48	88.9	89.1	89.3	89.4	89.6	89.8	90.0	90.2	90.4	90.6
49	90.7	90.9	91.1	91.3	91.5	91.7	91.9	92.0	92.2	92.4
50	92.6	92.8	93.0	93.1	93.3	93.5	93.7	93.9	94.1	94.3
51	94.4	94.6	94.8	95.0	95.2	95.4	95.6	95.7	95.9	96.1
52	96.3	96.5	96.7	96.9	97.0	97.2	97.4	97.6	97.8	98.0
53	98.1	98.3	98.5	98.7	98.9	99.1	99.3	99.4	99.6	99.8
54	100.0	100.2	100.4	100.6	100.7	100.9	101.1	101.3	101.5	101.7
55	101.9	102.0	102.2	102.4	102.6	102.8	103.0	103.1	103.3	103.5
56	103.7	103.9	104.1	104.3	104.4	104.6	104.8	105.0	105.2	105.4
57	105.6	105.7	105.9	106.1	106.3	106.5	106.7	106.9	107.0	107.2
58	107.4	107.6	107.8	108.0	108.1	108.3	108.5	108.7	108.9	109.1
59	109.3	109.4	109.6	109.8	110.0	110.2	110.4	110.6	110.7	110.9
60	111.1	111.3	111.5	111.7	111.9	112.0	112.2	112.4	112.6	112.8
61	113.0	113.1	113.3	113.5	113.7	113.9	114.1	114.3	114.4	114.6
62	114.8	115.0	115.2	115.4	115.6	115.7	115.9	116.1	116.3	116.5
63	116.7	116.9	117.0	117.2	117.4	117.6	117.8	118.0	118.1	118.3
64	118.5	118.7	118.9	119.1	119.3	119.4	119.6	119.8	120.0	120.2
65	120.4	120.6	120.7	120.9	121.1	121.3	121.5	121.7	121.9	122.0
66	122.2	122.4	122.6	122.8	123.0	123.1	123.3	123.5	123.7	123.9
67	124.1	124.3	124.4	124.6	124.8	125.0	125.2	125.4	125.6	125.7
68	125.9	126.1	126.3	126.5	126.7	126.9	127.0	127.2	127.4	127.6
69	127.8	128.0	128.1	128.3	128.5	128.7	128.9	129.1	129.3	129.4
70	129.6	129.8	130.0	130.2	130.4	130.6	130.7	130.9	131.1	113.3
71	131.5	131.7	131.9	132.0	132.2	132.4	132.6	132.8	133.0	133.1
72	133.3	133.5	133.7	133.9	134.1	134.2	134.4	134.6	134.8	135.0
73	135.2	135.4	135.6	135.7	135.9	136.1	136.3	136.5	136.7	136.9
74	137.0	137.2	137.4	137.6	137.8	138.0	138.1	138.3	138.5	138.7
75	138.9	139.1	139.3	139.4	139.6	139.8	140.0	140.2	140.4	140.6
76	140.7	140.9	141.1	141.3	141.5	141.7	141.9	142.0	142.2	142.4

TABLE 8.—*Cubic yards for sum of end areas*—Continued.

[Length of prism 100 feet.]

Sum of end areas.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
77	142.6	142.8	143.0	143.1	143.3	143.5	143.7	143.9	144.1	144.3
78	144.4	144.6	144.8	145.0	145.2	145.4	145.6	145.7	145.9	146.1
79	146.3	146.5	146.7	146.9	147.0	147.2	147.4	147.6	147.8	148.0
80	148.1	148.3	148.5	148.7	148.9	149.1	149.3	149.4	149.6	149.8
81	150.0	150.2	150.4	150.6	150.7	150.9	151.1	151.3	151.5	151.7
82	151.9	152.0	152.2	152.4	152.6	152.8	153.0	153.1	153.3	153.5
83	153.7	153.9	154.1	154.3	154.4	154.6	154.8	155.0	155.2	155.4
84	155.6	155.7	155.9	156.1	156.3	156.5	156.7	156.9	157.0	157.2
85	157.4	157.6	157.8	158.0	158.1	158.3	158.5	158.7	158.9	159.1
86	159.3	159.4	159.6	159.8	160.0	160.2	160.4	160.6	160.8	160.9
87	161.1	161.3	161.5	161.7	161.9	162.0	162.2	162.4	162.6	162.8
88	163.0	163.1	163.3	163.5	163.7	163.9	164.1	164.3	164.4	164.6
89	164.8	165.0	165.2	165.4	165.6	165.7	165.9	166.1	166.3	166.5
90	166.7	166.9	167.0	167 2	167.4	167.6	167.8	168.0	168.1	168.3
91	168.5	168.7	168.9	169.1	169.3	169.4	169.6	169.8	170.0	170.2
92	170.4	170.6	170.7	170.9	171.1	171.3	171.5	171.7	171.9	172.0
93	172.2	172.4	172.6	172.8	173.0	173.1	173.3	173.5	173.7	173.9
94	174.1	174.3	174.4	174.6	174.8	175.0	175.2	175.4	175.6	175.7
95	175.9	176.1	176.3	176.5	176.7	176.9	177.0	177.2	177.4	177.6
96	177.8	178.0	178.1	178.3	178.5	178.7	178.9	179.1	179.3	179.4
97	179.6	179.8	180.0	180.2	180.4	180.6	180.7	180.9	181.1	181.3
98	181.5	181.7	181.9	182.0	182.2	182.4	182.6	182.8	183.0	183.1
99	183.3	183.5	183.7	183.9	184.1	184.3	184.4	184.6	184.8	185.0
100	185.2	185.4	185.6	185.7	185.9	186.1	186.3	186.5	186.7	186.9
200	370.4	.....	700.0	1,296.3	.....	3,000.0	5,555.6	.....	8,000.0	14,814.8
300	555.6	.....	800.0	1,481.5	.....	4,000.0	7,407.4	.....	9,000.0	16,666.7
400	740.7	.....	900.0	1,666.7	.....	5,000.0	9,259.3	.....	10,000.0	18,518.5
500	925.9	.....	1,000.0	1,851.9	.....	6,000.0	11,111.1	.....	.....	.....
600	1,111.1	.....	2,000.0	3,703.7	.....	7,000.0	12,963.3	.....	.....	.....

NOTE.—By Wisconsin State Highway Commission.

TABLE 9.[1]—*Board measure.*

[Board feet per foot of length for various widths and thicknesses.]

Width in inches.	Thickness in inches.																		
0	1	1½	2	2½	3	3½	4	4½	5	5½	6	7	8	9	10	11	12	14	16
1	0.0833	0.1250	0.1667	0.2083	0.2500	0.2917	0.3333	0.3750	0.4167	0.4583	0.5000	0.5833	0.6667	0.7500	0.8333	0.9167	1.000	1.167	1.333
1½	.1250	.1875	.2500	.3125	.3750	.4063	.5000	.5625	.6250	.6875	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.500	1.750	2.000
2	.1667	.2500	.3333	.4688	.5625	.5833	.6667	.7500	.8333	.9167	1.0000	1.1670	1.3330	1.5000	1.6670	1.8330	2.000	2.333	2.667
2½	.2083	.3125	.4167	.5208	.6250	.7292	.8333	.9375	1.0420	1.1460	1.2500	1.4580	1.6670	1.8750	2.0830	2.2920	2.500	2.917	3.333
3	.2500	.3750	.5000	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.000	3.500	4.000
3½	.2917	.4375	.5833	.7292	.8750	1.0210	1.1670	1.3130	1.4580	1.6040	1.7500	2.0420	2.3330	2.6250	2.9170	3.2080	3.500	4.083	4.667
4	.3333	.5000	.6667	.8333	1.0000	1.1670	1.3330	1.5000	1.6670	1.8330	2.0000	2.3330	2.6670	3.0000	3.3330	3.6670	4.000	4.667	5.333
4½	.3750	.5625	.7500	.9375	1.1250	1.3130	1.5000	1.6880	1.8750	2.0630	2.2500	2.6250	3.0000	3.3750	3.7500	4.1250	4.500	5.250	6.000
5	.4167	.6250	.8333	1.0420	1.2500	1.4570	1.6660	1.8750	2.0830	2.2920	2.5000	2.9170	3.3330	3.7500	4.1670	4.5830	5.000	5.833	6.667
5½	.4583	.6875	.9167	1.1460	1.3750	1.6030	1.8330	2.0630	2.2920	2.5210	2.7500	3.2080	3.6670	4.1250	4.5830	5.0420	5.500	6.417	7.333
6	.5000	.7500	1.0000	1.2500	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.5000	4.0000	4.5000	5.0000	5.5000	6.000	7.000	8.000
7	.5833	.8750	1.1670	1.4580	1.7500	2.0420	2.3330	2.6250	2.9170	3.2080	3.5000	4.0830	4.6670	5.2500	5.8330	6.4170	7.000	8.167	9.333
8	.6667	1.0000	1.3330	1.6670	2.0000	2.3330	2.6670	3.0000	3.3330	3.6670	4.0000	4.6670	5.3330	6.0000	6.6670	7.3330	8.000	9.333	10.670
9	.7500	1.1250	1.5000	1.8750	2.2500	2.6250	3.0000	3.3750	3.7500	4.1250	4.5000	5.2490	6.0000	6.7500	7.5000	8.2500	9.000	10.500	12.000
10	.8333	1.2500	1.6670	2.0830	2.5000	2.9170	3.3330	3.7500	4.1670	4.5830	5.0000	5.8330	6.6670	7.5000	8.3330	9.1670	10.000	11.670	13.330
11	.9167	1.3750	1.8330	2.2920	2.7500	3.2080	3.6660	4.1250	4.5830	5.0420	5.5000	6.4170	7.3330	8.2500	9.1670	10.0800	11.000	12.830	14.670
12	1.0000	1.5000	2.0000	2.5000	3.0000	3.5000	4.0000	4.5000	5.0000	5.5000	6.0000	7.0000	8.0000	9.0000	10.0000	11.0000	12.000	14.000	16.000
13	1.0830	1.6250	2.1670	2.7080	3.2500	3.7920	4.3330	4.8750	5.4170	5.9580	6.5000	7.5830	8.6660	9.7500	10.8300	11.9200	13.000	15.170	17.330
14	1.1670	1.7500	2.3330	2.9170	3.5000	4.0830	4.6670	5.2500	5.8330	6.4170	7.0000	8.1670	9.3330	10.5000	11.6700	12.8300	14.000	16.330	18.670
15	1.2500	1.8750	2.5000	3.1250	3.7500	4.3750	5.0000	5.6250	6.2500	6.8750	7.5000	8.7500	10.0000	11.2500	12.5000	13.7500	15.000	17.500	20.000
16	1.3330	2.0000	2.6670	3.3330	4.0000	4.6670	5.3330	6.0000	6.6670	7.3330	8.0000	9.3330	10.6700	12.0000	13.3300	14.6700	16.000	18.670	21.330
18	1.5000	2.2500	3.0000	3.7500	4.5000	5.2500	6.0000	6.7500	7.5000	8.2500	9.0000	10.5000	12.0000	13.5000	15.0000	16.5000	18.000	21.000	24.000
20	1.6670	2.5000	3.3330	4.1670	5.0000	5.8330	6.6670	7.5000	8.3330	9.1670	10.0000	11.6700	13.3300	15.0000	16.6700	18.3300	20.000	23.330	26.670

[1] From Byrnes Inspection Pocket Book.

TABLE 10.—

Rate.	Hours.										
	¼	½	¾	1	2	3	4	5	6	7	8
$0.100	$0.02	$0.05	$0.07	$0.10	$0.20	$0.30	$0.40	$0.50	$0.60	$0.70	$0.80
.105	.02	.05	.07	.10	.21	.31	.42	.52	.63	.73	.84
.110	.02	.05	.08	.11	.22	.33	.44	.55	.66	.77	.88
.115	.03	.06	.08	.11	.23	.34	.46	.57	.69	.80	.92
.120	.03	.06	.09	.12	.24	.36	.48	.60	.72	.84	.96
.125	.03	.06	.09	.12	.25	.37	.50	.62	.75	.87	1.00
.130	.03	.06	.09	.13	.26	.39	.52	.65	.78	.91	1.04
.135	.03	.07	.10	.13	.27	.40	.54	.67	.81	.94	1.08
.140	.03	.07	.10	.14	.28	.42	.56	.70	.84	.98	1.12
.145	.03	.07	.10	.14	.29	.43	.58	.72	.87	1.01	1.16
.150	.03	.07	.11	.15	.30	.45	.60	.75	.90	1.05	1.20
.155	.04	.08	.12	.15	.31	.46	.62	.77	.93	1.08	1.24
.160	.04	.08	.12	.16	.32	.48	.64	.80	.96	1.12	1.28
.165	.04	.08	.12	.16	.33	.49	.66	.82	.99	1.15	1.32
.170	.04	.08	.12	.17	.34	.51	.68	.85	1.02	1.19	1.36
.175	.04	.09	.13	.17	.35	.52	.70	.87	1.05	1.22	1.40
.180	.04	.09	.13	.18	.36	.54	.72	.90	1.08	1.26	1.44
.185	.04	.09	.13	.18	.37	.55	.74	.92	1.11	1.29	1.48
.190	.04	.09	.14	.19	.38	.57	.76	.95	1.14	1.33	1.52
.195	.05	.10	.14	.19	.39	.58	.78	.97	1.17	1.36	1.56
.200	.05	.10	.15	.20	.40	.60	.80	1.00	1.20	1.40	1.60
.225	.06	.11	.17	.22	.45	.67	.90	1.12	1.35	1.57	1.80
.250	.06	.12	.19	.25	.50	.75	1.00	1.25	1.50	1.75	2.00
.275	.07	.14	.21	.27	.55	.82	1.10	1.37	1.65	1.92	2.20
.300	.07	.15	.22	.30	.60	.90	1.20	1.50	1.80	2.10	2.40
.325	.08	.16	.24	.32	.65	.97	1.30	1.62	1.95	2.27	2.60
.350	.08	.17	.26	.35	.70	1.05	1.40	1.75	2.10	2.45	2.80
.375	.09	.19	.28	.37	.75	1.12	1.50	1.87	2.25	2.62	3.00
.400	.10	.20	.30	.40	.80	1.20	1.60	2.00	2.40	2.80	3.20
.425	.10	.21	.31	.42	.85	1.27	1.70	2.12	2.55	2.97	3.40
.450	.11	.22	.34	.45	.90	1.35	1.80	2.25	2.70	3.15	3.60
.475	.12	.24	.36	.47	.95	1.42	1.90	2.37	2.85	3.32	3.80
.500	.12	.25	.37	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00
.525	.13	.26	.39	.52	1.05	1.57	2.10	2.62	3.15	3.67	4.20
.550	.14	.27	.41	.55	1.10	1.65	2.20	2.75	3.30	3.85	4.40
.575	.14	.28	.43	.57	1.15	1.72	2.30	2.87	3.45	4.02	4.60
.600	.15	.30	.45	.60	1.20	1.80	2.40	3.00	3.60	4.20	4.80
.625	.15	.31	.47	.62	1.25	1.87	2.50	3.12	3.75	4.38	5.00
.650	.16	.32	.49	.65	1.30	1.95	2.60	3.25	3.90	4.55	5.20
.675	.17	.34	.50	.67	1.35	2.02	2.70	3.37	4.05	4.72	5.40
.700	.17	.35	.52	.70	1.40	2.10	2.80	3.50	4.20	4.90	5.60
.725	.18	.36	.54	.72	1.45	2.17	2.90	3.62	4.35	5.07	5.80
.750	.19	.37	.56	.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00
.775	.19	.39	.58	.77	1.55	2.32	3.10	3.87	4.65	5.42	6.20
.800	.20	.40	.60	.80	1.60	2.40	3.20	4.00	4.80	5.60	6.40
.825	.21	.41	.62	.82	1.65	2.47	3.30	4.12	4.95	5.77	6.60
.850	.21	.42	.64	.85	1.70	2.55	3.40	4.25	5.10	5.95	6.80
.875	.22	.44	.66	.87	1.75	2.62	3.50	4.37	5.25	6.12	7.00
.900	.22	.45	.67	.90	1.80	2.70	3.60	4.50	5.40	6.30	7.20
.925	.23	.46	.69	.92	1.85	2.77	3.70	4.62	5.55	6.47	7.40
.950	.24	.47	.71	.95	1.90	2.85	3.80	4.75	5.70	6.65	7.60
.975	.24	.49	.73	.97	1.95	2.92	3.90	4.87	5.85	6.82	7.80
1.000	.25	.50	.75	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00

Wage table.

Hours—Continued.											Rate.
9	10	20	30	40	50	60	70	80	90	100	
$0.90	$1.00	$2.00	$3.00	$4.00	$5.00	$6.00	$7.00	$8.00	$9.00	$10.00	$0.100
.94	1.05	2.10	3.15	4.20	5.25	6.30	7.35	8.40	9.45	10.50	.105
.99	1.10	2.20	3.30	4.40	5.50	6.60	7.70	8.80	9.90	11.00	.110
1.03	1.15	2.30	3.45	4.60	5.75	6.90	8.05	9.20	10.35	11.50	.115
1.08	1.20	2.40	3.60	4.80	6.00	7.20	8.40	9.60	10.80	12.00	.120
1.12	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50	.125
1.17	1.30	2.60	3.90	5.20	6.50	7.80	9.10	10.40	11.70	13.00	.130
1.21	1.35	2.70	4.05	5.40	6.75	8.10	9.45	10.80	12.15	13.50	.135
1.26	1.40	2.80	4.20	5.60	7.00	8.40	9.80	11.20	12.60	14.00	.140
1.30	1.45	2.90	4.35	5.80	7.25	8.70	10.15	11.60	13.05	14.50	.145
1.35	1.50	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	.150
1.39	1.55	3.10	4.65	6.20	7.75	9.30	10.85	12.40	13.95	15.50	.155
1.44	1.60	3.20	4.80	6.40	8.00	9.60	11.20	12.80	14.40	16.00	.160
1.48	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20	14.85	16.50	.165
1.53	1.70	3.40	5.10	6.80	8.50	10.20	11.90	13.60	15.30	17.00	.170
1.57	1.75	3.50	5.25	7.00	8.75	10.50	12.25	14.00	15.75	17.50	.175
1.62	1.80	3.60	5.40	7.20	9.00	10.80	12.60	14.40	16.20	18.00	.180
1.66	1.85	3.70	5.55	7.40	9.25	11.10	12.95	14.80	16.65	18.50	.185
1.71	1.90	3.80	5.70	7.60	9.50	11.40	13.30	15.20	17.10	19.00	.190
1.75	1.95	3.90	5.85	7.80	9.75	11.70	13.65	15.60	17.55	19.50	.195
1.80	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	.200
2.02	2.25	4.50	6.75	9.00	11.25	13.50	15.75	18.00	20.25	22.50	.225
2.25	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	.250
2.47	2.75	5.50	8.25	11.00	13.75	16.50	19.25	22.00	24.75	27.50	.275
2.70	3.00	6.00	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00	.300
2.92	3.25	6.50	9.75	13.00	16.25	19.50	22.25	26.00	29.25	32.50	.325
3.15	3.50	7.00	10.50	14.00	17.50	21.00	24.50	28.00	31.50	35.00	.350
3.37	3.75	7.50	11.25	15.00	18.75	22.50	26.25	30.00	33.25	37.50	.375
3.60	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	.400
3.82	4.25	8.50	12.75	17.00	21.25	25.50	29.75	34.00	38.25	42.50	.425
4.05	4.50	9.00	13.50	18.00	22.50	27.00	31.50	36.00	40.50	45.00	.450
4.27	4.75	9.50	14.25	19.00	23.75	28.50	33.25	38.00	42.25	47.50	.475
4.50	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	.500
4.72	5.25	10.50	15.75	21.00	26.25	31.50	36.25	42.00	47.25	52.50	.525
4.95	5.50	11.00	16.50	22.00	27.50	33.00	38.50	44.00	49.50	55.00	.550
5.17	5.75	11.50	17.25	23.00	28.75	34.50	40.25	46.00	51.75	57.50	.575
5.40	6.00	12.00	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00	.600
5.62	6.25	12.50	18.75	25.00	31.25	37.50	43.75	50.00	56.25	62.50	.625
5.85	6.50	13.00	19.50	26.00	32.50	39.00	45.50	52.00	58.50	65.00	.650
6.07	6.75	13.50	20.25	27.00	33.75	40.50	47.25	54.00	60.75	67.50	.675
6.30	7.00	14.00	21.00	28.00	35.00	42.00	49.00	56.00	63.00	70.00	.700
6.52	7.25	14.50	21.75	29.00	36.25	43.50	50.75	58.00	65.25	72.50	.725
6.75	7.50	15.00	22.50	30.00	37.50	45.00	52.50	60.00	67.50	75.00	.750
6.97	7.75	15.50	23.25	31.00	38.75	46.50	54.25	62.00	69.75	77.50	.775
7.20	8.00	16.00	24.00	32.00	40.00	48.00	56.00	64.00	72.00	80.00	.800
7.42	8.25	16.50	24.75	33.00	41.25	49.50	57.75	66.00	74.25	82.50	.825
7.65	8.50	17.00	25.50	34.00	42.50	51.00	59.50	68.00	76.50	85.00	.850
7.87	8.75	17.50	26.25	35.00	43.75	52.50	61.25	70.00	78.75	87.50	.875
8.10	9.00	18.00	27.00	36.00	45.00	54.00	63.00	72.00	81.00	90.00	.900
8.32	9.25	18.50	27.75	37.00	46.25	55.50	64.75	74.00	83.25	92.50	.925
8.55	9.50	19.00	28.50	38.00	47.50	57.00	66.50	76.00	85.50	95.00	.950
8.77	9.75	19.50	29.25	39.00	48.75	58.50	68.25	78.00	87.75	97.50	.975
9.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	1.000

PLANT AND EQUIPMENT RENTAL TABLE.

The information contained in this table has been gathered from various sources and as complete data are given in connection therewith as were available at the time it was secured. While all of the rates given were those actually used on construction work, their use as a basis for rentals in specific cases is not recommended.

Schedule of rental rates used during the season 1917 on work of considerable magnitude.

[The rates mentioned are per day.]

Automobiles	$5.00
Adding and listing machines	.20
Buckets, tipple and bottom dump	.25
Boring machine, pneumatic	.50
Boring machine, electric	.50
Buckets, orange-peel, 1 yard	3.50
Buckets, orange-peel, less than 1 yard	2.00
Buckets, clamshell	2.00
Boiler, and 3-drum engine	3.50
Boiler, and 2-drum engine	3.00
Boiler, and 1-drum engine	2.50
Boiler only, 30 horsepower and smaller	1.50
Boiler only, larger than 30 horsepower	2.00
Block machine, concrete	1.50
Cars, skip, 1½ yards	.25
Cars, skip, 3 yards	.50
Cars, steel, 1 yard and smaller	.15
Cars, 4 yards, wooden	.25
Cars, 6 yards, wooden	.75
Cars, 12 yards, wooden	2.00
Cars, 1 hopper, radial gate	.25
Crushers only	2.00
Crushers, with elevator and screen	3.00
Conveyor, gravity, per 100 feet	1.00
Compressor, 10 by 10 with steam engine	2.50
Compressor, 8 by 8 belt driven	1.00
Compressor, with gasoline engine on wheels	5.00
Compressor, Westinghouse, 9½ inch	1.00
Cableways, without engine	4.00
Drill, auto traction	5.00
Dump wagons	.25
Diving outfit with pumps	10.00
Derricks, 60 feet to 85 feet	2.00
Derricks, 30 feet to 59 feet	1.50
Derricks, less than 30 feet	1.00
Derricks, breast	.25
Derricks, circle swing	.25
Elevators, platform or bucket	.25
Elevators, with bins for concrete	.50
Engines, skeleton, 3 drum	2.00
Engines, skeleton, 2 drum	1.50
Engines, skeleton, 1 drum	1.00
Engines, steam, horizontal, 11 to 40 horsepower	1.50

Engines, steam, upright, to 10 horsepower	$0.50
Engines, gasoline, to 8 horsepower	.50
Engines, 2-drum, with electric motor	4.00
Engines, gasoline, 10 horsepower	1.00
Engines, derrick, swinging	.50
Hammers, riveting	.25
Hod elevating machine	1.00
Leveling instruments, engineers'	.25
Locomotive, 36-inch gauge	5.00
Locomotive, standard gauge	10.00
Mixers, with boiler sideloader	4.00
Mixers, with electric motors, 1 yard	4.00
Mixers without boiler, less than 1 yard	2.00
Mixers without boiler, 1 yard and larger	3.50
Mixers with gasoline engine	3.00
Motorcycles	1.00
Motors, 2 horsepower	.15
Motors, 5 horsepower	.25
Motors, 10 horsepower	.50
Motors, 25 horsepower	1.00
Motors, 50 horsepower	2.00
Pumps, centrifugal, 10-inch, belt driven	3.00
Pumps, centrifugal, 10-inch, with motor attached	4.00
Pumps, centrifugal, 8-inch, steam connected	2.00
Pumps, centrifugal, 6-inch, steam connected	1.50
Pumps, centrifugal, 4-inch, steam connected	1.00
Pumps, duplex and triplex to 3-inch	.50
Pumps, pulsometor to 4-inch	1.55
Pumps, diaphragm	.20
Pumps, diaphragm, with gas engine	1.05
Pumps, triplex, with belt drive	.20
Pile drivers, drop	1.50
Pile drivers, drop, with single drum engine and boiler	3.50
Pile hammers, steam, up to 2,500 pounds	3.00
Pile hammers, steam, larger than 2,500 pounds	5.00
Rail, per ton	.06
Roller, horse	1.00
Steam drills	1.00
Small air drills	.50
Steam roller	8.00
Steam shovel	30.00
Sprinkling cart	1.00
Saw benches	.25
Saw benches, with motor or gasoline engine	.50
Scale boxes	.25
Scraper, wheel	.50
Transits	.50
Typewriter	.10

Fuel and lubricants were not included in these prices, nor was the cost of repairs, all of which were borne by the organization using the equipment. All equipment was to be returned to the owner in good condition.

Rental paid for use of equipment on State highway work during the year 1917, by contract.

Air compressor drill outfits while necessarily on site of work, per day	$3.00
Crusher, including screens and bins, per day	8.00
Concrete mixer and labor, per cubic yard of concrete	.60–1.72
Grader while necessarily on site of work, per day	15.00
Steam roller, per linear foot of roadway rolled	.06
Steam shovel while necessarily on site of work, per day	20.00

Small tools, such as lanterns, rubber boots, axes, hammers, drills, bars, plows, harrows, picks, shovels, wheelbarrows, and of like character, were included in the unit prices paid for completed work. The work was done by a contractor who was paid a fixed amount for units of work completed. All materials used were paid for by the State. The contractor furnished coal, oil, repairs, etc., for his equipment at the rentals quoted.

Rental paid for use of equipment on State highway work, season of 1917; work done by State forces, equipment owned by towns and individuals.

Boilers, about 25 horsepower, per day	$5.00
Crusher, screens, bins, and engine, per day	10.00
Heater (for stone) and engine, per day	5.00
Mixer and steam engine, per day	5.00
Water cart, per day	.50
Truck, 3-ton capacity, driver, fuel, repairs, and all supplies necessary, per day	18.00

Fuel, lubricant, and repairs furnished by State.

REFERENCES.

The authors acknowledge their indebtedness to the following sources of information:

The cost-account systems of the following State highway departments: Arizona, Illinois, Maryland, Oregon, Pennsylvania, and Wisconsin; "Efficient Cost Keeping," by E. St. Elmo Lewis; "Efficiency," by Harrington Emerson; "Cost Data," by H. P. Gillette; "Cost-Keeping and Scientific Management," by H. A. Evans; "Cost Records for Executives as a Means of Plant Control," by B. A. Franklin; "Cost Accounting and Management Engineering," by H. P. Gillette and R. P. Dana; "Cost Accounts," by L. W. Hawkins; "Psychology and Industrial Efficiency," by Hugo Munsterberg; "Cost Accounts," by J. L. Nicholson; "The Principles of Scientific Management," by Frederick W. Taylor; "Cost Accounting," by J. R. Wildman; "Modern Accounting," by H. R. Hatfield; "The Handbook of Municipal Accounting," by the Bureau of Municipal Research; The Cost-Accounting System of the Ontario Highway Department; the Cost-Accounting System used by the Bureau of Public Works of the Philippine Islands; an article on "Cost Accounting," by Capt. Godfrey, and the subsequent discussions on the subject in the Army Engineers' Magazine; "Memoirs of Army Engineers;" and in addition the Study of Cost-Accounting Systems in use in many counties, cities, and towns in the United States, and the chapter on "Cost Finding" in Volume XI of the Alexander Hamilton Institute, and the Transactions of the American Society of Civil Engineers.

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 661

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. ▼ April 9, 1918

THE MANUFACTURE OF CASEIN FROM BUTTERMILK OR SKIM MILK.[1]

By Arnold O. Dahlberg,[2] *of the Dairy Division.*

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IMPORTANCE OF CASEIN MANUFACTURE TO CREAMERIES.

The utilization of by-products by a large number of small creameries is daily becoming of more economic importance. Because of the ever-increasing competition, the future success of many creameries depends in no small degree upon both the quality of their products and the extent to which by-products may be profitably utilized. The small creameries usually receive a good quality of raw material

[1] Acknowledgment is made of the courtesy of the Robert Gair Co., Brooklyn, N. Y., and the Dill & Collins Co., Philadelphia, for hearty cooperation and assistance in running coating tests on their large commercial machines, which involved considerable inconvenience and expense, but gave valuable information as to the practical value and working properties of the samples submitted. Special thanks are extended to Ernest Hafele and H. A. Sawyer, chemists for the companies mentioned, for their patience and interest in arranging for the various tests and for making it possible to obtain information relative to the application of casein in the paper industry.

The J. A. & W. Bird & Co., Boston; the Casein Manufacturing Co., New York, and the Union Casein Co., Philadelphia, furnished information and data which were of great value in the work.

In the earlier part of this investigation the Bureau of Standards of the Department of Commerce kindly placed at our disposal equipment for investigation on the solubility of casein, and the assistance of F. C. Clark of that bureau in this connection was of value.

[2] The investigation of the manufacture of casein from buttermilk was begun by Dr. F. J. Birchard, formerly of the Dairy Division, and after his departure the work was taken up by the writer.

and probably can obtain greater efficiency through quality rather than quantity. When a good grade of cream is received, not only can a high-quality butter be made, but the buttermilk can be more profitably utilized.

In the past skim-milk casein is the only kind that has been made in large quantities. However, many creameries have a considerable quantity of buttermilk, which is not disposed of to the best advantage, and this by-product can be made to realize a profit to the creamery and produce greater returns to the farmer if it is made into a good grade of casein. It is possible to make profitably a good grade of casein from buttermilk when good raw material is received, provided the buttermilk does not bring exceptional prices for food. It is, of course, advisable to convert the buttermilk into food products when proper markets can be obtained, as greater profits usually can be derived from it in that form. It is not always possible to utilize all the buttermilk to the best advantage as a food product, and it is important to be able to turn the surplus into casein, which is a good-keeping product and finds a ready market. As dried casein of good quality can be marketed in unlimited quantities, its manufacture acts as a safety valve in utilizing any surplus buttermilk or skim milk.

THE MANUFACTURE OF CASEIN FROM BUTTERMILK.

The recovery of casein from buttermilk by the method to be outlined is dependent upon the normal acidity of the buttermilk. Sweet buttermilk must be ripened until the proper degree of acidity has developed. The sour buttermilk from the churn, or that which has developed the required acidity by ripening, is heated sufficiently to cause a rapid separation of the curd and whey. Owing to the fineness of buttermilk curd every precaution must be taken to prevent it from being broken up any finer, which makes handling more difficult. Turning steam directly into the buttermilk has too great a tendency to break the curd up and make handling more difficult. The method devised for heating the buttermilk to obtain a rapid and clear separation of the curd in such manner as to give favorable conditions throughout the rest of the process consists in running it through a steam jet or ejector. In this way the desired temperature can be obtained in a rapid and efficient manner and with very little agitation of the curd. With buttermilk of sufficient acidity there should be no difficulty in getting a good separation at a temperature varying between 115° and 130° F. (46.11° and 54.44° C). (See fig. 1.) The proper temperature to get the characteristic clear and rapid separation of the curd from a given lot of buttermilk can readily be ascertained at the start of a run by catching

samples of the heated buttermilk in a glass tumbler as it comes from the ejector. By varying the temperature, that which will give the best results is determined. At that temperature the curd immediately rises to the top, leaving a clear whey below.

This method is based upon results obtained in devising and putting into operation a practical method for handling the surplus

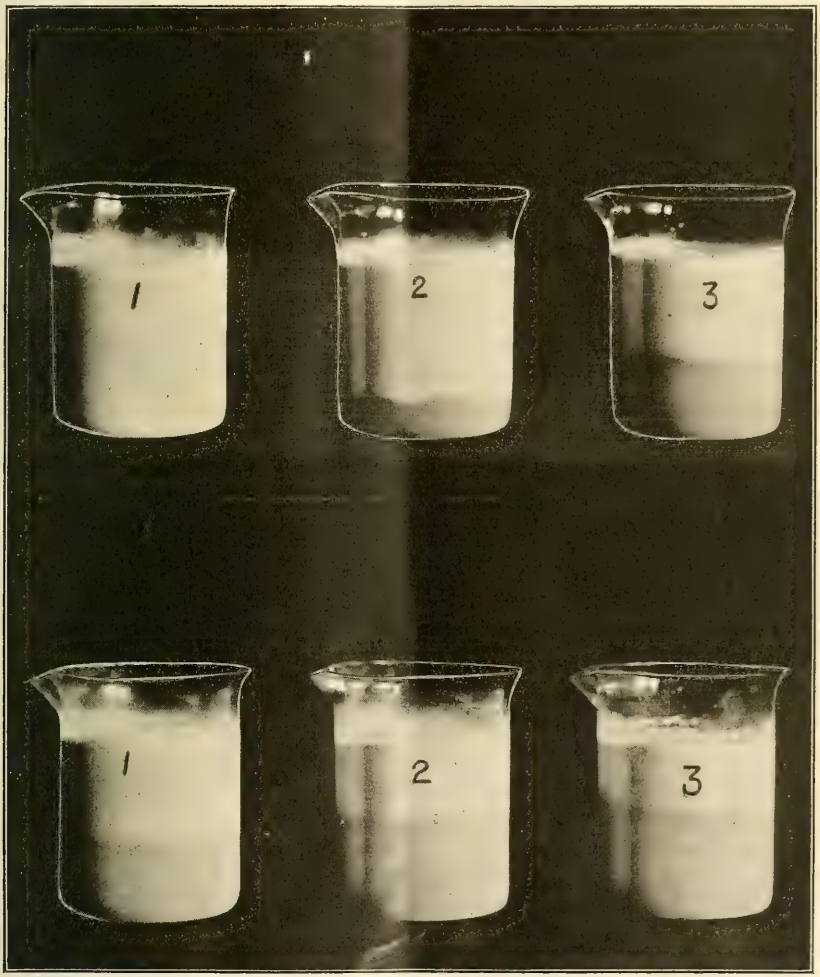

FIG. 1.—Proper heating with the ejector gives a rapid and clear separation. Upper row of beakers shows extent of separation, heating to 115° F. (46.11° C.) at one, two, and five minutes, while lower row shows the same thing heating to 125° F. (51.67° C.)

buttermilk of the Grove City Creamery, Grove City, Pa., operated under the supervision of the Dairy Division, United States Department of Agriculture, and therefore has received a thorough trial in a commercial creamery, where it is giving most satisfactory results. Any creamery with similar raw material, by the applica-

tion of principles within its control, can obtain like results. While the study of the effect of the different factors upon the quality of the casein was carried on with samples made from experimental lots, the directions for manufacturing are derived from observations taken when making the product in a commercial way and under conditions comparable with those of the ordinary creamery. The methods given for making skim-milk casein were likewise tried in a commercial way in the Grove City Creamery.

DIRECTIONS FOR MANUFACTURING BUTTERMILK CASEIN.

PRECIPITATING THE CURD.

The buttermilk from the churn is pumped into a tank elevated sufficiently to allow it to run by gravity through an ejector and from there into another tank below, whose gate valve is high enough to let the drain rack, mounted on casters, run under it. Such arrangement makes handling most convenient and with the least labor. The size of tanks and ejectors depends upon the quantity of material to be handled. To save time, the heating should be done quickly. A valve placed in the buttermilk pipe leading from the tank to the ejector, and one in the steam pipe next to the ejector, permit easy control of the temperature to which the buttermilk must be heated to obtain proper separation.

The temperature necessary to obtain a clear and rapid separation of the curd from a lot of buttermilk depends to some extent upon the acidity, and can be ascertained at first by taking samples of the heated buttermilk as it comes from the ejector. While conclusive data bearing directly upon the degree of acidity required for the most favorable results have not been obtained, an acidity of from 0.65 to 0.80 per cent at the time of precipitation apparently gives the best working conditions. Buttermilk which has been allowed to stand too long and develop a high acidity has a tendency to give a soft, sticky curd difficult to handle, especially when a high precipitating temperature is used. By varying the temperature used, the proper degree of heat necessary to get good results may be obtained. At that temperature the curd begins to rise to the top quickly, leaving the clear whey below. When it comes from the ejector the buttermilk is in such condition that the curd invariably rises to the top. As soon as the curd has massed at the surface, which requires only a few minutes, the greater portion of the whey can be drawn from the bottom of the vat into the cloth-lined drain rack. The clear whey passes through the drain cloth quickly and by gradually closing the gate valve as the curd lowers in the vat, practically all of it can be drained away. When the whey has drained away, the hot curd is placed on the drain racks, ready for washing. Every pos-

sible precaution should be taken in handling the sour buttermilk not to agitate it unnecessarily by pumping or in any other manner, as it breaks the curd up finer and makes handling more difficult.

WASHING THE CURD.

After all of the hot curd has been placed on the drain cloth, it is washed at least twice with cold water, which apparently hardens the curd particles and makes handling easier. The use of a shower-bath spray nozzle attached to the water hose is advantageous in washing the curd, for with it the massed curd can be broken up and washed better. Draining is hastened by giving the drain cloth a quick pull from one side to the other. After a few trials no difficulty should be encountered in peeling the curd clean from the drain cloth in order to afford better drainage surface. The curd is given a thorough soaking each time, care being used to get the whole mass of particles in contact with the water. Under proper conditions the curd drains readily but it always should be allowed to stand a short time between washings. Individual experience will show the best method of washing the curd in the shortest time and still get the desired results.

The number of washings required will depend on the thoroughness with which the work is done. The drain water coming from the pressed curd should test less than .20 per cent acidity, which is possible with two washings if ample time is allowed for each drainage. Continuous attention is unnecessary when the curd is on the drain racks. The greater portion of a man's time during that period is available for other work unless a very large quantity of buttermilk is to be handled. After the last washing the curd is allowed to drain well in order to save time in putting to press. Trouble is encountered in getting a stack of wet curd in press cloths to press evenly, and at the outset it takes up more space in the press.

PRESSING.

A form made of 1-inch surfaced material 20 inches square and 8 inches deep is placed at the bottom of the press rack and lined with two press cloths. After placing in the form the proper quantity of wet curd the cloths are neatly turned over from both sides in a manner to hold the curd securely when pressure is applied, special care being given to the corners, where trouble is most liable to occur. The form is then removed and a dividing board placed on top of the mass of wet curd, when the form can be replaced and the process continued until all the curd has been taken care of. The quantity of wet curd placed in the press cloths depends somewhat on the condition of the curd and can be determined best by experience.

When all the curd is placed in the cloths heavy pressure is applied by means of jackscrews until the following morning or until the curd is sufficiently dry for satisfactory grinding. In case some one is not at the plant all the time some method for maintaining a continuous, heavy pressure must be provided, as the expulsion of moisture from the curd under pressure quickly releases the tension. A satisfactory device for obtaining such pressure can be made easily and added to the regular press rack by means of heavy railway-car springs. When pressure is first applied to the curd a little attention is necessary to get the curd to press evenly; afterwards the jackscrews have to be tightened only occasionally.

GRINDING.

Provided the pressure has been ample, no trouble will be experienced the following morning in properly grinding the curd. The curd should not be taken from the press until it is sufficiently dry for proper grinding and drying. In this condition grinding produces a fine, mealy curd that spreads well and does not adhere in lumps to prevent favorable drying conditions. When sufficient moisture has not been pressed from the curd, serious difficulties are experienced, as it is extremely hard, if not impossible, to grind a wet, soggy curd. After grinding, the curd must be dry and mealy, so that it may be spread easily upon the drying trays and permitted to dry thoroughly and quickly. Ground curd, if wet, can not be spread satisfactorily, and not only adheres in lumps that are very difficult to dry, but in drying they form a hard, impervious, bonelike outside surface, while the interior still remains moist.

The curd should be ground fine enough to allow it to dry rapidly and thoroughly. The importance of the thorough pressing and grinding of the curd can be appreciated readily when consideration is given to the following factors:

Steam for drying is saved.

Finely ground curd gives a lighter colored and much better looking grade of casein as it comes from the drying tunnel.

The curd requires a shorter period of heating.

More curd can be handled in a given time, thus increasing the efficiency of the plant.

There is less wear and tear on the machinery.

PLACING THE GROUND CURD ON THE DRYING TRAYS.

A fine-mesh screening must be used for the drying trays, as the buttermilk casein is very fine and not flaky like that made from skim milk by the addition of commercial acid. The finely ground curd is most easily spread upon the drying trays shortly after grinding. While the work can be done by the usual method of throwing a shovelful of the ground curd on a tray and then spreading it with

the hands, better results can be obtained by the use of a simple shaker screen, similar to those used for screening sand and gravel. A box arrangement that is supplied with ground curd by means of a hopper permits the empty trays to be pushed under the screen. A box of that kind can be quickly made at very little cost and will save time and also spread the curd in a uniform thickness, which affords the best drying conditions. When the curd is not spread uniformly the drying time is increased to the time necessary to dry the thickest parts. As the trays are filled they are stacked upon wooden trucks provided with swivel casters, for convenience in running them in and out of the drier.

DRYING.

The stacked trays, with the curd uniformly spread on each, are run into the tunnel drier where a current of heated air is passed over them. The time required for proper drying depends on:

The condition of the curd.
The uniformity of the spreading on the trays.
The volume and temperature of the air passing over the curd.

The volume and speed of the air current blowing over the curd should not be excessive, but sufficient to carry the moisture off readily. When the air current is too swift much of the fine dried casein is blown off the trays. A temperature of 130° F. (54.44° C.) has apparently no detrimental effect upon the casein and is sufficiently high for all purposes. Casein dried at that temperature comes from the drier in a fine-grained condition and breaks up very easily, while that dried at a higher temperature has more tendency to adhere in one mass and is harder to grind to the same degree of fineness. High temperature results in casein that is more difficult to dissolve, particularly in the presence of greater quantities of fat. High temperatures are also very liable to cause discoloration of the casein, especially when impurities, resulting from either poor raw material or faults in the process of manufacture, are present. A temperature no higher than is necessary and never exceeding 130° F. (54.44° C.) should be used in order to lessen the danger of obtaining a darker colored casein. In order to get a product that will keep well it is important to dry the casein thoroughly before it is removed from the drier. It is an easy matter to ascertain when a properly ground curd is dry, but great care must be exercised in determining when a coarsely ground one is ready to be taken from the drier. Since large particles of curd dry slowly they must be broken or cut in two to find out whether the inside is properly dried. No trouble need be experienced in drying the casein completely within 7 hours at a temperature of 130° F. (54.44° C.), provided the curd has been properly ground and spread upon the trays in the proper manner.

REMOVING DRIED CURD OR CASEIN FROM THE TRAYS.

When the curd has been properly ground and uniformly spread upon the trays the finished casein comes from the drier in good physical condition and it can be collected easily by turning the trays over a bin and giving them a slight jar. If grinding and drying conditions have been unfavorable the casein does not come from the trays so easily, as it does not have the same granular form and has more tendency to stick to the screening. This is especially true in the case of a high-fat buttermilk curd which has not been washed sufficiently to remove the sugar and other soluble impurities.

GRINDING AND PACKING CASEIN.

It is advisable to grind and screen the casein after it comes from the drying tunnel in order that it may be of uniform grain and appearance. In the marketing of casein uniformity is of as much importance from the standpoint of appearance as in the case of other products. Grinding a coarse-grained casein makes the color considerably lighter, which is much desired. For grinding, a small burr-feed grinder gives satisfactory results and can be procured at small expense. The finished casein is placed in strong burlap or grain sacks in which it is shipped to market. Care must be taken, while awaiting shipment, to store the casein in a dry place where, if properly made, it will keep for several months.

YIELD OF BUTTERMILK CASEIN.

Depending upon its physical condition at the time of precipitation, 100 pounds of undiluted buttermilk yields on the average from 2.8 to 3.1 pounds of dried casein. Coagulated buttermilk which has been broken up by mechanical agitation, such as pumping or stirring, gives a very fine curd, much of which is liable to be lost through the drain cloth. In ascertaining the yield, the quantity of water added to the cream in rinsing the vat and utensils should be taken into consideration if correct figures are desired. In many creameries the cream is diluted with an unnecessarily large quantity of water before it reaches the churn, and in such instances the yield of casein, based on the actual weight of the diluted buttermilk, is considerably lower.

COST OF MANUFACTURE.

No definite figures can be given on the cost of manufacturing, as cost-accounting data were not kept when a sufficient quantity of buttermilk was handled to give results applicable to ordinary creamery conditions. The cost of making is governed largely by the volume of business. When, in order to take care of surplus material, only

occasional runs are made, the cost is considerably higher than when the volume of business carried on is sufficient to permit the most efficient and economical use of labor and equipment. If 10,000 or more pounds of buttermilk is handled daily the cost of making dried casein should not exceed 3 cents a pound.

The cost of making casein from skim milk is less than that from buttermilk, as it does not require nearly so much work. Several concerns that were making a large quantity of skim-milk casein regularly estimated that the cost of manufacture was between 1 and 1½ cents a pound, although they had no detailed cost-accounting figures. It is probable that the cost will be more than is ordinarily estimated by those without definite figures, since, in figuring it, the depreciation and the interest on the cost of equipment should be included with the expense of labor, steam, and other items.

EQUIPMENT REQUIRED.

For making buttermilk casein, the necessary apparatus, besides the storage tank and precipitating vat which are already available in most creameries, consists of the following:

Drying tunnel with fan blower and heating coils.
Drying trays.
Trucks for holding the drying trays.
Curd mill.
Curd press.
Press dividing boards.
Drain rack.
Cloths for draining and pressing the curd.

Practically the same equipment is needed for making skim-milk casein, with the exception of the drain rack, which ordinarily is not used.

It is advisable to make the tunnel drier larger than the immediate demands require. When being constructed this can be done at comparatively little additional expense and it allows, without inconvenience, expansion of the plant. The remainder of the equipment can be increased easily at any time.

Many creameries that do not have buttermilk enough to warrant putting in the complete drying apparatus precipitate the curd, press a large part of the moisture out, and sell it in that condition. In that case the curd is received at a central plant where it is ground and dried. If a market can be obtained for the wet curd the only additional apparatus required, besides the vats, are the drain rack, curd press, dividing boards, and the cloths for draining and pressing, all of which are available at comparatively small expense. The item of greatest cost is the apparatus for drying the casein, which consists of the drying tunnel with fan blower and heating coils, drying trays,

trucks to hold the trays, and the curd mill. Several creameries may combine to maintain a central drying plant and ship their green curd to the plant for drying; this is advisable if each plant, because of the small quantity of curd handled, can not afford a complete equipment.

TUNNEL DRIER.

The best type of drier is made of tongue-and-groove boards nailed both sides of the studding, the space between being filled preferably

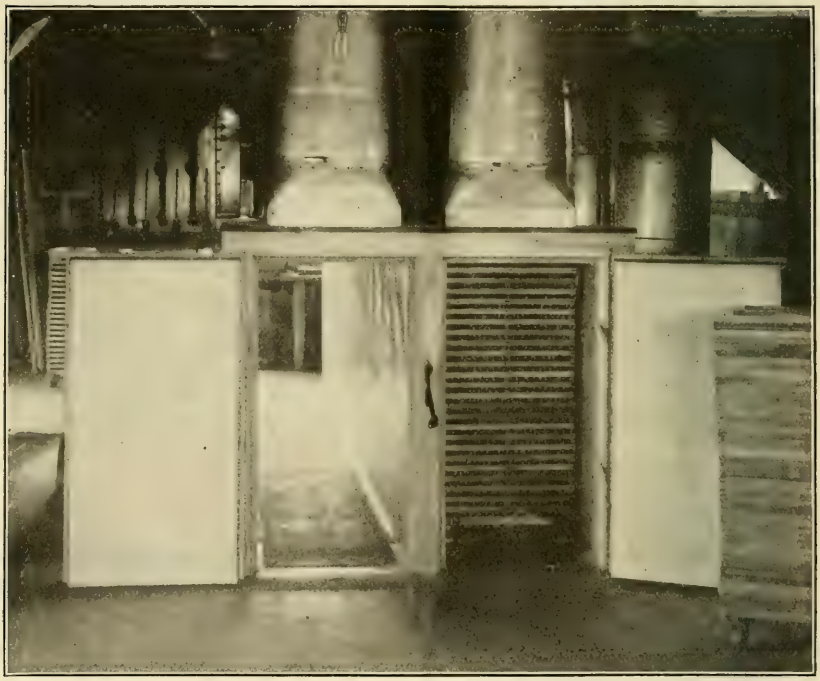

FIG. 2.—Well-constructed double-tunnel drier lined with galvanized iron. Two large pipes take off the heated air after it has passed over the casein. Steam radiator for heating the air shown at top and farther end of tunnel.

with dry sawdust or other insulating material. It is advisable to line the tunnels with galvanized iron if they are to be used continuously, as the large volume of heated air passing through them dries the boards out to a considerable extent. A cheaper type of construction consists in nailing tongue-and-groove boards on only one side of the studding. While, because of leaks and other losses, that kind of drier is not so economical of the heated air, it gives satisfactory results. It is more economical of both space and construction to have a double-tunnel drier built along the wall where it will be least in the way. The tunnel should be made one inch wider than the trucks and drying trays, to allow sufficient room for moving the

stacked trays freely through it. Many tunnels are made 31 or 32 inches wide to accommodate the 30-inch-square drying trays which can be purchased ready-made. The tunnels used in our experiments were 24 inches wide (fig. 2). A double-tunnel drier, 22 feet long, 5 feet high, and each tunnel 24 inches wide, when filled with drying trays will hold the casein from 20,000 pounds of buttermilk. The driers can be made of any length and height but it is advisable to have them high enough to allow a man to walk in without inconvenience when pushing the trays in or out. Full-width doors are placed on each end of the tunnels, so that the trucks stacked full of trays may be pushed in at one end and out at the other, which facilitates and systematizes the work. The cost of a drying tunnel can be ascertained by considering the type of construction and the price of material and labor available in the locality.

BLOWER AND HEATING APPARATUS.

A low-pressure blower of sufficient capacity to provide a large volume of heated air over the ground curd is required. No exact figures as to the cost of a blower can be given. One of the casein jobbers quotes a price of $35 on a blower and $50 for a heater which has sufficient radiating surface to heat the air to the required temperature. The additional expense of installing the apparatus, supposed to have a capacity for drying the casein from 15,000 pounds of milk daily, should also be considered. It may be possible to make a pipe heater at the factory more cheaply than it can be purchased, but if the best results are to be obtained care must be taken to have the proper radiating surface.

DRYING TRAYS AND TRUCKS.

Satisfactory drying trays of the desired size can be made of $\frac{7}{8}$-inch square strips and galvanized screening. A rectangular frame is made of the strips, which are mortised and glued at the corners. Another strip is mortised lengthwise of the frame. Galvanized screening, 16 meshes to the inch, such as is used for windows and doors, is tacked to one side of the frame, after which $\frac{1}{2}$-inch by $\frac{7}{8}$-inch strips are placed over the screen, flush with the lengthwise strip, and fastened with screws. The three strips forming the bottom of the tray allow a free circulation of air through the stacked trays, and in addition materially strengthen it. Canvas or unbleached muslin used on the bottom tray of each truck, in place of the screening, serves to catch the fine particles of dried casein that drop through the upper trays. With galvanized-wire screening at the prices that prevailed in 1914, when the experimental equipment was installed, the 23 by 30 inch trays may be made for $7 a dozen and the 30 by 30 inch trays for about $9 a dozen.

The trucks for holding the drying trays are made of surfaced 2 by 4 inch lumber, or other suitable material, the same size as the trays, and have mortised joints and a swivel caster at each corner. Strong and serviceable trucks can be made complete for $2.50 each. Much cheaper trucks can be made, of course, but it is doubtful whether they would prove to be more economical in the end. The number of trucks and trays needed depends to a large extent upon the time in which the casein is to be dried. Twelve wooden trucks and 30 dozen trays should be available to handle 15,000 pounds of buttermilk daily. By loading them more heavily, more buttermilk can be

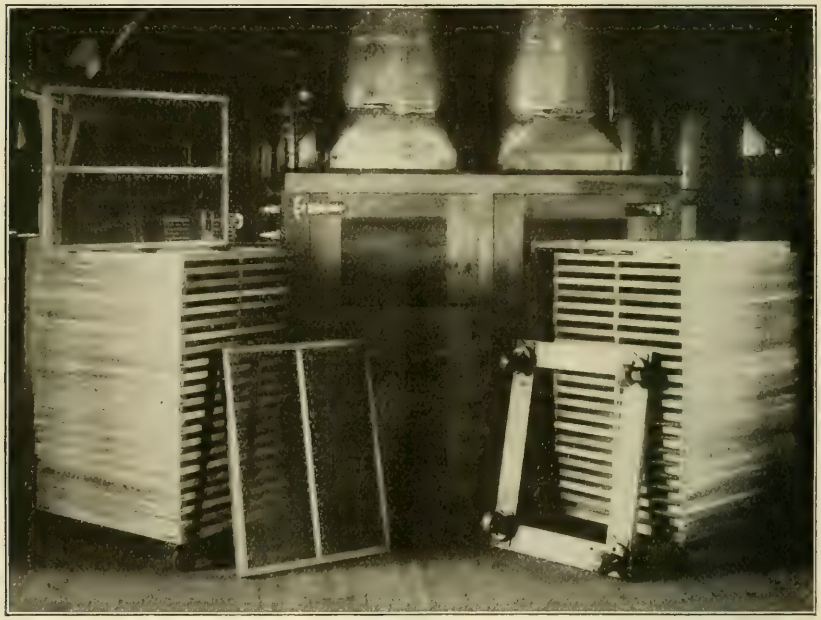

FIG. 3.—Screen-covered drying trays and caster trucks used in drying the ground curd.

handled with the same number of trays, but in this case the time of drying is materially increased.

CURD MILL.

The importance of getting the right kind of curd mill, which is used to grind the green curd taken from the press, can not be overestimated. If the curd is not ground properly the most favorable drying conditions can not be obtained. In order to do satisfactory grinding the mill should have both the shredding and beating features possessed by the better machines (see fig. 4). The shredding part consists of a comparatively slow-revolving cylinder fitted with sharp-peg teeth to tear the large masses of curd into small pieces

that fall into the lower cylindrical drum in which a rapidly revolving iron beater drives the curd through a medium-mesh screen. For the curd of not more than 20,000 pounds of buttermilk a curd mill having both features referred to and one which is suitable for satisfactory work can be purchased for about $50. If more material is to

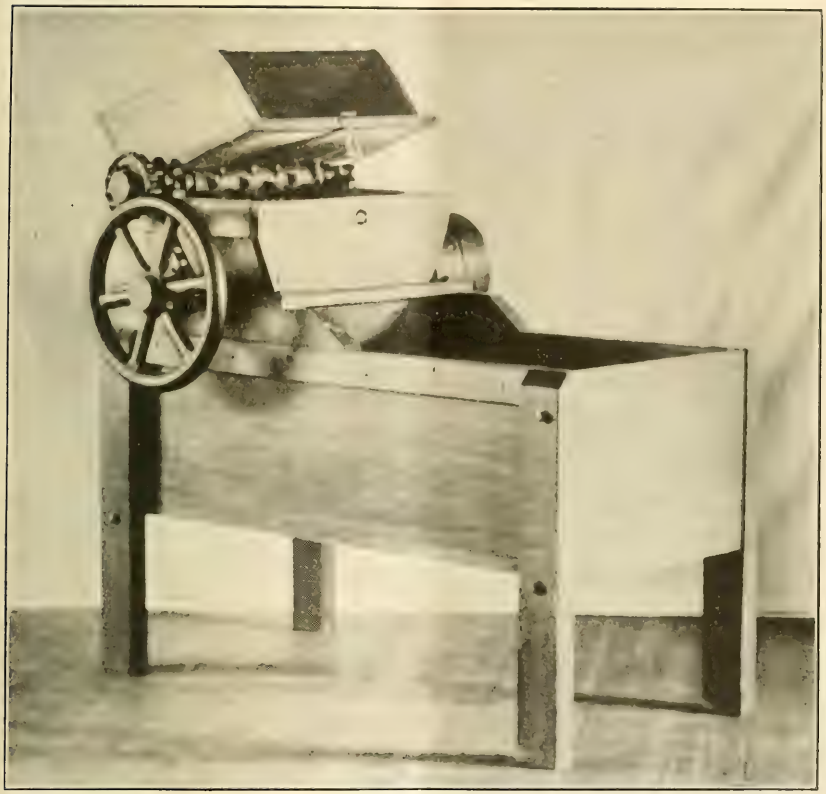

FIG. 4.—An inexpensive but satisfactory type of curd mill, possessing both the shredding and revolving beater features.

be handled regularly it is advisable to purchase a larger, better constructed, and more expensive mill.

CURD PRESS.

The curd press is subjected to a heavy strain and necessarily must be strongly constructed. A sufficiently strong press rack can be made easily of 4 by 4 inch material held together with $\frac{5}{8}$-inch iron bolts. Two pieces of 4 by 4 inch surfaced material 5 feet long and 2 pieces 4 feet long are made into a rectangular form, the 5-foot pieces being fastened to the shorter ones by the use of a $\frac{3}{4}$-inch mortise in such manner as to leave a 30-inch space between the inner edges

of the longer pieces. This allows for a 5-inch projection of each end of the shorter pieces. A 32-inch piece of 4 by 4 inch fitted at the middle into one of the short pieces, so as to form a cross, serves as the floor support. Fourteen-inch pieces of 4 by 4 inch are toenailed to the crosspiece at each end flush with the uprights. On the top of the floor support surfaced boards are nailed. It is advisable to place a shallow pan of galvanized iron on top of the boards for the purpose of diverting the drainage water to one side, thus preventing it from running on to the lower part of the press rack. The uprights of the rack are braced from the opposite sides, the brace running from the outside edge of the floor platform to a point about 30 inches above on the upright. The whole press frame is bolted together with $\frac{5}{8}$-inch bolts which are as long as the uprights, and one is placed parallel with and on the inside of each upright. Heavy iron plates are used for washers on the top and bottom crosspieces. Press jackscrews can be placed in the top crosspiece, which should be of 4 by 6 inch material or with ordinary jackscrews 4 by 4 inch material may be used.

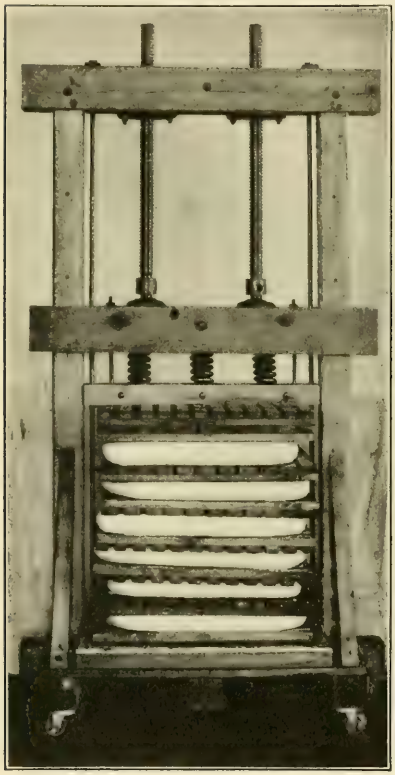

FIG. 5.—Curd press, showing manner of pressing moisture from curd. By means of heavy car springs a continuous heavy pressure may be maintained.

A press of the dimensions given will hold the curd of 5,000 pounds of buttermilk and can be made for about $15, including all labor, material, and two jackscrews. By increasing the cross dimensions a larger press can be made, and it may be advisable to make one wide enough to accommodate a mass of curd 30 inches square. It will be found advantageous to use two jackscrews in each press to facilitate handling the wet curd. The tendency of the moist curd to press unevenly can be better controlled by applying pressure with two jackscrews instead of one. If no one is at the plant to maintain a continuous pressure on the curd in the press, some other means, such as the use of heavy railway-car springs, should be provided to maintain the pressure.

DRAIN RACK.

A drain rack such as is used in the manufacture of cottage cheese is very satisfactory. It should be made either of cypress or of a good grade of white pine. A frame 3 feet 4 inches wide by 6 feet 4 inches long, outside dimensions, is made of surfaced 2 by 4 inch material, using mortised joints and allowing the ends of the longer pieces to project 3 inches. The frame is made by laying the 2 by 4 inch pieces flat. On the inside edge of each piece a $\frac{7}{8}$-inch hole about 2 inches deep is bored every 12 inches, and a $\frac{1}{2}$-inch galvanized pipe of the proper length is placed in the holes when putting the frame together. The pipes support the wire screening and keep it from getting loose. Three galvanized swivel casters are fastened to each side on the bottom of the frame to allow the drain rack to be handled conven-

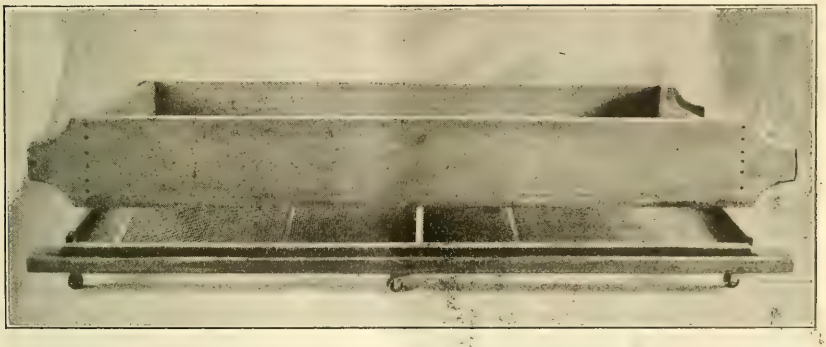

FIG. 6.—Drain rack mounted on swivel casters allows most convenient handling, especially when filled with curd.

iently. Galvanized-wire screening of four meshes to the inch is nailed to the top of the frame with staples, taking care to draw it tight and let it extend a little over the middle of the frame all around. A wooden strip, wide enough to cover the edge of the galvanized screening, is nailed around the outside edge of the upper part of the frame to hold the top part in proper position. The top part is made of $1\frac{1}{2}$ by 12 inch surfaced material with mortised and spiked corner joints, each end of the side pieces projecting 6 inches. The projections, trimmed down to the shape of a handle, make the rack more convenient.

Two drain racks of the dimensions given are large enough to hold the curd from 400 gallons of buttermilk. The curd drains quickly in the drain racks, which permits them to be used repeatedly until all the casein is made.

PRESS FORM-DIVIDING BOARDS.

The dividing boards placed between the layers of wet curd in the press can be made conveniently from 1 by $1\frac{1}{2}$ inch lattice-stop strips

surfaced on all sides. The strips are cut in 26-inch lengths and nailed crosswise to one another, allowing 1 inch between strips; the dividing board is then 26 inches square and is suitable for the press described. A smaller space than 1 inch between the strips makes washing difficult, while a much larger one allows the curd to project, which causes unsatisfactory pressing. For making the dividing boards use good clear wood which can be washed easily. It is advisable also to give all form-dividing boards at least two coats of raw linseed oil before using, to reduce the water-retaining capacity of the wood. The boards are kept wet while in use and unless oiled well

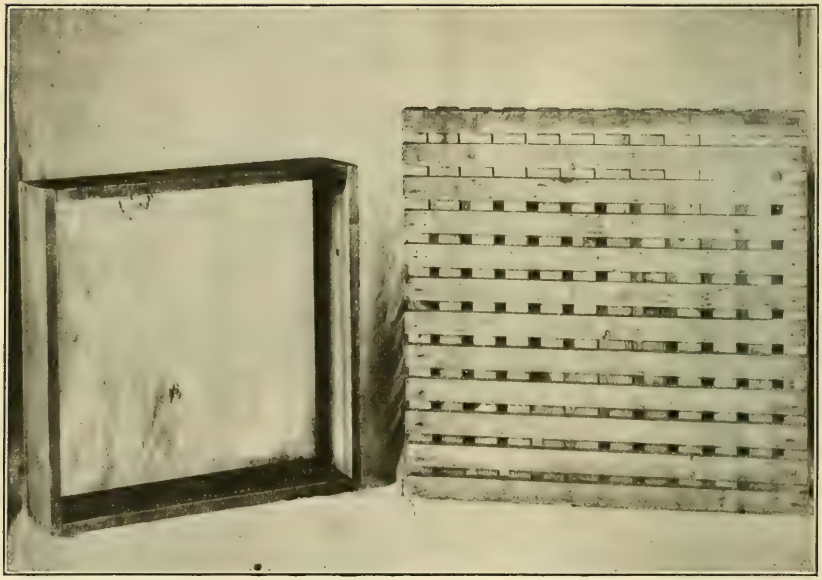

FIG. 7.—Dividing board and form used in putting the curd into the press cloths.

will soon become heavy with moisture. They must be scrubbed well each day with hot water and a brush, to prevent offensive odors. When lattice-stop strips cost 1.3 cents a linear foot, allowing for carpenter's time, the dividing boards of the size indicated can be made for about 95 cents each.

DRAIN AND PRESS CLOTHS.

Experience with several kinds of cloth, both for draining and pressing the curd, has shown that certain kinds of material are to be preferred. The drain cloth must be strong to prevent tearing in manipulating the heavy wet curd, must allow easy drainage, and must be easy to wash. Ordinary burlap makes a strong, serviceable drain cloth which no doubt will outlast any other material. Cheese-

cloth is not strong enough to make a satisfactory drain cloth. Two pieces of 36-inch burlap three yards long, sewed together at the middle with a treble seam, make a drain cloth of suitable size for a drain rack 3 feet wide, 6 feet long, and 12 inches deep. The edge of the cloth should be hemmed to prevent raveling and unnecessary wear.

For pressing the wet curd 10-ounce duck seems to be most satisfactory, since it has the greatest strength, is easy to wash, and does not allow the curd to escape. Burlap of a very close weave can be used, but is much harder to wash. Unbleached muslin is satisfactory but does not equal the duck. Any of the materials mentioned can be obtained in widths suitable for making cloths of the proper size to use with the curd press and dividing boards described. Pieces 41 inches long, cut from a 40-inch bolt, after the torn edge has been hemmed to prevent raveling, make cloths of suitable size for a form 20 inches square and 8 inches deep.

FACTORS INFLUENCING THE QUALITY OF BUTTERMILK CASEIN.

The difference and variation in chemical composition and physical condition of buttermilk make it hard to control absolutely all conditions which may influence the quality of the casein. In making the different lots of buttermilk casein conditions were controlled so far as was practicable, so that the factor studied was the only variable introduced. That makes it possible to observe, on a fair and comparative basis, the effect of any factor under consideration.

The factors that have an important influence upon the quality of the buttermilk casein are:

Fat content of buttermilk.
Washing the precipitated curd.
Temperature of drying the ground curd.
Temperature of precipitating the curd.
Acidity of buttermilk at the time of precipitation.

FAT CONTENT OF BUTTERMILK.

Since all the fat originally in the buttermilk is concentrated in the dried casein it probably will have a deleterious effect upon the strength and general working properties of the casein. An increased quantity of fat yields not only a casein of poorer solubility and strength, but also a solution of poorer physical qualities. A lot of buttermilk was divided into two parts and fat in the form of cream added to one part, which was used as a basis for observing the effect of increased fat content upon the quality of the casein.

TABLE 1.—*Effect of fat content of buttermilk on strength of casein.*

Buttermilk.			Times curd washed.	Acidity of drain water.	Drying temperature.	Fat in buttermilk.	Casein required.
Lot No.	Portion No.	Acidity.					
		Per cent.		*Per cent.*	°*F.*	*Per cent.*	*Grams.*
56.17	17A	0.95	4	0.035	130	1.2	12
56.17	17B	1.00	3	.20	130	.07	10
56.30	30A	.85	4	.015	130	.02	9
56.30	30B	.88	4	.015	130	.30	10
56.53	53D	.67	4	.09	125	.05	9
56.53	53D	.70	4	.07	125	.50	10
56.53	53A	.67	4	.10	165	.05	9
56.53	53C	.70	4	.06	165	.50	11
56.55	55A	.82	4	.02	125	.07	8
56.55	55C	.82	4	.01	125	.32	9+
56.55	55B	.83	4	.02	160	.07	8
56.55	55D	.83	4	.01	160	.32	9
56.58	58A	.87	4	.02	125	.06	9
56.58	58B	.86	4	.02	125	.27	9
56.62	62A	.80	4	.015	125	.04	7
56.62	62B	.80	4	.02	125	.35	8
56.64	64A	.....	4	.03	125	.11	7+
56.64	64B	.....	4	.03	125	.28	7
56.64	64C	.....	4	.04	160	.11	8
56.64	64D	.....	4	.03	160	.28	8
56.71	71A	.....	4	.06	125	.08	8+
56.71	71C	.....	4	.07	125	.30	9
56.71	71B	.....	4	.10	175	.08	8
56.71	71D	.....	4	.07	175	.30	9
56.72	72A	.....	4	.04	125	.08	7
56.72	72C	.....	4	.05	125	.30	8+
56.73	73A	.....	4	.02	125	.20	8+
56.73	73C	.....	4	.00	125	.80	9+
56.73	73B	.....	4	.02	168	.20	9
56.73	73D	.....	4	.01	168	.80	10
56.74	74A	.....	4	.01	125	.2	7+
56.74	74C	.....	4	.02	125	.8	9−
56.84	84A	.....	0	.46	126	.17	8
56.84	84C	.....	0	.38	126	.50	10
56.84	84B	.....	0	.37	162	.17	8
56.84	84D	.....	0	.40	162	.50	10+
56.87	87A	.....	3	.05	126	.28	8−
56.87	87C	.....	3	.03	126	.83	9−
56.87	87B	.....	0	.48	126	.28	8+
56.87	87D	.....	0	.41	126	.75	9

Table 1 shows the comparative strength of different lots in terms of grams of casein required to hold the coating mixture properly. If it is assumed that the difference in strength is caused entirely by the extra fat content we find that in lot 56.17 the low-fat buttermilk casein was 20 per cent stronger than the higher-fat buttermilk, while in lot 56.30 the difference in strength in favor of the low-fat buttermilk casein was 11 per cent. The greater strength shown by the low-fat buttermilk casein in practically all instances is more significant when it is considered that the high-fat buttermilk casein showed decreased strength together with poorer handling qualities. The increased quantity of fat has a detrimental effect upon the physical working qualities of the dissolved casein, producing a thin, weak-bodied solution of greatly reduced viscosity which upon cooling has a tendency to become a greasy mixture of poor spreading qualities.

Having in view trying out the effect of increased fat content with a high drying temperature as compared with a low temperature, lots

of low-fat buttermilk were divided into two portions and cream added to the one to make it high in fat. The low-fat and high-fat portions were then subdivided into two portions. All portions were run as nearly alike as possible until time of drying, when one low-fat and one high-fat portion were dried at normal temperature, and the other set of low-fat and high-fat portions were dried at a temperature far in excess of that recommended for the best results. This gives a combination of factors which makes it difficult to judge the deleterious effect of the fat content upon the quality of casein. Lots numbered 56.64, 56.71, and 56.73, Table 1, involving the two influencing factors, do not show so much difference in strength with the high fat and high drying temperature as may be expected. It must be understood, though, that the wax test is by no means a sensitive one, merely giving rough comparative results, and for that reason can not be relied upon to measure accurately the actual relative strength of given samples of casein. This point should be borne in mind in considering the data and discussion relating to the effect of the various factors upon the strength of the casein samples reported upon in this work. In Lot No. 56.84 three influencing factors are introduced—washing, drying temperature, and fat content—and the difference in strength of these samples is very pronounced. The difference in strength in this set of samples can not be attributed altogether to the fat content, for the lack of washing the curd and the higher drying temperature have a probable influence which must be given due consideration.

WASHING THE CURD.

Contrary to a current opinion existing among casein firms, particularly with reference to skim-milk casein, the investigational work indicates that the washing of the buttermilk curd is of importance. Washing removes the free whey and with it lactose and soluble salts which may serve as impurities in the casein. While the effect of the salts which may be removed by washing has not been definitely determined, it is reasonable to conclude that the presence of an excess of lactic acid adds complications and in that way favors a deterioration in quality, since the washed-curd casein from high-acid buttermilk shows greater strength. Soluble salts retained in the curd in their natural form probably do not have a direct effect upon the quality of casein, but their presence, in connection with other factors such as high fat content and high drying temperature, may injure the quality. The ash content of the casein indicates to a certain extent the salts present, and while it serves as a guide in judging whether the curd has been washed it can not be depended upon as a reliable indicator of the quality of the casein.

TABLE 2.—*The effect of washing curd on the strength of the casein.*

Buttermilk.			Buttermilk fat content.	Times curd washed.	Acidity of drain water.	Drying temperature.	Casein required.	Ash.	Fat.	H_2O.
Lot No.	Portion No.	Acidity.								
		Per cent.	*Per cent.*		*Per cent.*	*° F.*	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*
56.9	9A	0.82	0.20	0	0.60	125	12	1.65	23.32	5.84
56.9	9B	.82	.20	4	.04	125	10	0.26	22.55	5.33
56.10	10A	.72	.16	2	.19	125	9	1.18	5.86	7.14
56.10	10B	.72	.16	4	.05	125	9	0.88	6.04	7.65
56.20	20A	.81	.01	0	.54	125	9	2.18	4.29	5.91
56.20	20B	.81	.01	4	.14	125	9	1.26	4.07	5.68
56.31	31A	.81	.12	0	.58	125	9	.....	.....	.....
56.31	31B	.81	.12	4	.05	125	8	.....	.....	.....
56.35	35A	.65	.19	0	.44	125	9	2.38	4.18	5.90
56.35	35B	.65	.19	5	.07	125	9	0.86	4.66	6.14
56.50	50A	.67	.06	0	.42	125	8	.....	.....	.....
56.50	50B	.67	.06	2	.14	125	8	.....	.....	.....
56.52	52A	.74	.32	0	.42	125	9	.....	.....	.....
56.52	52B	.76	.32	4	.04	125	8 +	.....	.....	.....
56.52	52C	.97	.32	0	.57	125	10	.....	.....	.....
56.52	52D	.96	.32	4	.02	125	9	.....	.....	.....
56.54	54AC	.63	.07	4	.04	125	9	.....	.....	.....
56.54	54BD	.63	.07	0	.37	125	9 +	.....	.....	.....
56.56	56A	.93	.14	0	.56	125	10	.....	.....	.....
56.56	56B	.93	.14	4	.02	125	8 +	.....	.....	.....

Table 2 gives data on the effect of washing the curd upon the strength of the casein. The increased strength consistently shown in the washed curd from high-acid buttermilk emphasizes the importance of washing the curd from that kind of material. No noticeable increase in strength could be found, however, in the washed curd of low-acid buttermilk. Any difference in strength appears more marked in the samples made from buttermilk of higher acidity or fat content, substantiating the assumption that it was caused by a combination of factors which by themselves may not have any direct effect. The samples from the unwashed curd, taken as a whole, required more time to effect a complete solution, which may have been caused by the free acid remaining in the whey rather than by any injury to the quality of the casein. A portion of the alkali is used up in neutralizing the free acid found in the unwashed-curd casein, thus leaving a weaker solution for dissolving the sample. The reaction accounts for the decreased quantity of alkali found necessary to dissolve the casein from a well-washed curd.

DRYING TEMPERATURE OF THE CURD.

A high drying temperature in combination with one of the other factors has an injurious effect upon the quality of the casein which is most pronounced with a high-fat or unwashed curd. A well-washed curd from buttermilk of a low-fat content can be dried at a relatively high temperature with no apparent injury to the quality, but it is not to be recommended. The lower the temperature the less probability of injuring the quality, and for that reason the lowest temperature possible should be used. A temperature of 130° F.

(54.44° C.) is satisfactory for quick drying and should have no injurious effect upon the quality of the casein.

TABLE 3.—*Effect of drying temperature on strength of casein.*

Buttermilk.		Times curd washed.	Acidity of drain water.	Fat in buttermilk.	Drying temperature.	Casein required.
Lot No.	Portion No.					
			Per cent.	*Per cent.*	*° F.*	*Grams.*
56.15	15A	4	0.07	0.35	125	9
56.15	15B	4	.07	.35	150	9
56.16	16A	4	.02	.60	130	8
56.16	16B	4	.02	.60	160	9
56.20	20B	4	.14	.01	125	9
56.20	20C	4	.14	.01	93	9
56.23	23A	4	.005	.13	130	9
56.23	23B	4	.005	.13	160	9+
56.53	53A	4	.10	.05	165	9
56.53	53B	4	.09	.05	125	9
56.53	53C	4	.06	.50	165	11
56.53	53D	4	.07	.50	125	10
56.55	55A	4	.02	.07	125	8
56.55	55B	4	.02	.07	160	8
56.64	64A	4	.03	.11	125	7+
56.64	64C	4	.04	.11	160	8
56.64	64B	4	.03	.28	125	7
56.64	64D	4	.03	.28	160	8
56.71	71A	4	.06	.08	125	8+
56.71	71B	4	.10	.08	175	8
56.71	71C	4	.07	.30	125	9
56.71	71D	4	.07	.30	175	9
56.73	73A	4	.02	.20	125	8+
56.73	73B	4	.02	.20	168	9
56.73	73C	4	.00	.80	125	9+
56.73	73D	4	.01	.80	168	10

Table 3 shows the effect of the drying temperature upon the strength of the casein. There are no apparent differences in strength from low-fat buttermilk; but with the higher-fat buttermilk a difference in strength, attributable to the higher-drying temperature, is noted. No apparent differences in strength show up consistently with the low-fat buttermilk due to the high drying temperature. While the differences in strength of the high-fat portions of buttermilk in Lots 56.53, 56.64, 56.71, and 56.73 do not show up so markedly as would be expected, they nevertheless indicate clearly the weakening effect which a high drying temperature has upon the quality of casein from buttermilk high in fat.

PRECIPITATING TEMPERATURE.

The temperature of precipitating the curd is not of great importance, as the range of heat which may be used in obtaining a rapid and clear separation of curd from whey does not permit a temperature high enough materially to affect the quality of the casein. Precipitation of the curd is accomplished within certain limits which, if exceeded, will fail to give the characteristic separation desired. A high precipitating temperature, particularly with buttermilk of high acidity, causes the mixture to reemulsify, thus

preventing separation. The precipitating temperature, under normal conditions, is largely controlled by the process itself and ordinarily is not high enough to cause material injury to the quality of the casein.

ACIDITY OF BUTTERMILK.

The acidity of buttermilk at the time of precipitation is of importance only when the curd is not well washed, the effect of which is discussed under "Washing the curd." When high-acid buttermilk curd is well washed no appreciable difference in the strength of the casein can be distinguished. High-acid buttermilk is more liable to give trouble in handling and so should be avoided whenever it is possible.

THE MANUFACTURE OF SKIM-MILK CASEIN.

SULPHURIC-ACID METHOD.

The usual method of making skim-milk casein is that of adding crude commercial sulphuric acid to the fresh skim milk after heating the latter to a temperature of 120° F. (48.89° C.). The advantage of this method is that the skim milk can be disposed of quickly and at a time when the quality of the curd is in the best condition.

The fresh skim milk is run into a vat, generally of wood because of its cheapness and the deteriorating effect of acid upon a metal vat. It is there heated with direct steam to a temperature of 120° F. (48.89° C.) and never higher than 125° F. (51.67° C.). Commercial sulphuric acid, of the strength used for making Babcock tests (1.83 specific gravity), is then added at the rate of one pint to every 1,000 pounds of milk, at the same time stirring the mixture continuously. Before using, each pint of acid should be diluted with about a gallon of water, always pouring the acid into the water and not vice versa. After the addition of the acid the skim milk is stirred gently until a good separation of the curd is obtained, as indicated by the clearness of the whey. This usually takes but a few minutes, provided sufficient acid has been used. In case the curd does not separate well, leaving a clear whey, more acid can be added to get the proper results. The quantity of acid required for a good, clear separation varies somewhat, depending upon its strength and the condition of the milk. The proper quantity can be determined easily if the vat is marked off so as to show how much milk is on hand for each run. By varying the quantity of acid used from day to day the proportion that gives the best results can be ascertained. The clear whey is run through the gate valve at once, and the curd remaining in the vat is rinsed with cold water to remove the excess of whey and the free acid remaining. When the curd in the vat has drained it is placed in

burlap press cloths and put to press. While burlap is generally used for pressing the skim-milk curd it is not so satisfactory as duck, since the curd adheres to it more and makes washing more difficult. Continuous heavy pressure is applied until sufficient whey has been expelled to permit satisfactory grinding. The time required depends upon the degree of pressure and the condition of the curd. The usual practice is to allow the curd to remain in the press over night. After it has been pressed properly the curd is taken from the press and, after being run through the curd mill, the ground curd is placed upon the trays and dried in the tunnel drier.

PRESSED-CURD METHOD.

Creameries without a sufficient quantity of skim milk to justify the expense of installing a complete plant for manufacturing the dried casein may ship the pressed curd to a central drying plant, several of which are maintained by casein jobbers in creamery districts. At the central drying plant the green-pressed curd is ground, dried, and paid for on the basis of dried casein obtained. When the pressed curd is shipped the only equipment required besides the vat is the press, press cloths, and dividing boards, none of which are expensive.

The green curd has to be shipped frequently during the warm weather, unless it can be kept in a refrigerator, and must remain in transit only a very short time. The green-pressed curd soon begins to mold, which has an injurious effect upon the quality of the casein.

COOKED-CURD METHOD.

The cooked-curd method of making skim-milk casein is coming into more general use among the creameries in districts convenient to a central drying plant. This method requires practically no equipment except the precipitating vat. The process of precipitating is the same as that used for pressed curd; that is, the skim milk is heated to 120° F. (48.89° C.) and sulphuric acid added at the rate required to separate properly. After draining the whey off the curd is broken up in the vat, covered with water, and the mixture heated to a temperature of 170° to 175° F. (76.67° to 79.44° C.) by means of direct steam. At that temperature all the curd should collect in a semifluid, plastic, tough mass. The water is drained off and the soft curd placed in a barrel, where it settles into an almost air-tight mass which upon cooling changes to a very tough, impervious mass that will keep for several days, even in hot weather. Fresh-cooked curd can be put on top of the hardened curd in a barrel partially filled from a previous batch. The barrels filled with cooked curd and covered with burlap can be shipped to the central drying plant without danger of breaking. Cooked curd is very hard to grind and requires an especially strong mill.

No more acid than is required to give a clear separation should be used, as an excess seriously interferes with the proper working of the cooked-curd method. When too much acid is added, the curd, when cooked in the water, does not collect in the characteristic plastic mass but breaks up fine, making it difficult to handle. When the proper quantity of acid has been used in precipitating the curd, the clear whey shows an acidity of from 0.30 to 0.32 per cent. If it shows more than 0.34 per cent acidity, trouble is liable to be encountered in obtaining the characteristic fusion of the curd at the

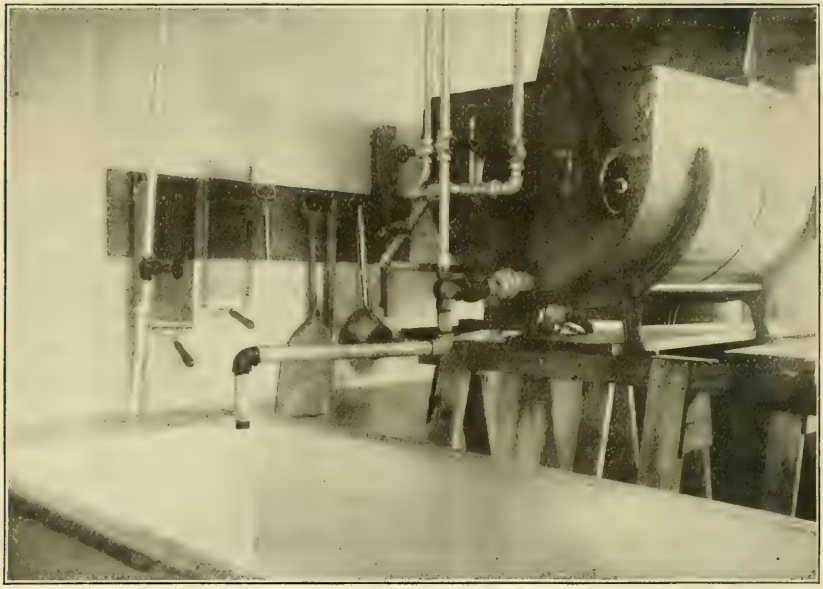

FIG. 8.—Connecting the ejector to a tank elevated sufficiently to allow heated buttermilk to be run into a vat below gives satisfactory working conditions.

time of heating. A good plan to follow in preventing the use of an excess of acid is to measure out what the directions call for—one pint to a 1,000 pounds of skim milk—dilute all of it with water, and then add a portion at a time, using just what is necessary to effect a clear and complete separation.

EJECTOR METHOD.

Casein can be made successfully from skim milk with the ejector method of precipitating the curd, but care must be taken in allowing the skim milk to curdle before heating, or a tough, rubbery curd, impossible to handle, will result. When skim milk is allowed to curdle by the formation of lactic acid and without agitation, then there is no trouble in getting a clear and quick separation of the curd which can be handled well in every respect. The curd from naturally soured skim milk, separated by the ejector method of heating, is not

only handled as easily as that precipitated with sulphuric acid but is not nearly so tough nor so hard to grind.

COMPARISON OF THE DIFFERENT METHODS OF MAKING SKIM-MILK CASEIN.

The quality of casein made by the ejector method is superior in many ways to that made with the acid and cooked-curd methods. It shows better strength, dissolves more readily, and retains a fluid, viscous body at room temperature, giving it better working properties. When dissolving acid and cooked-curd casein, complete solution is retarded by the formation of a heavy, short, viscous body, which upon cooling has a decided tendency to congeal and lose its fluidity, more especially the cooked-curd casein, making it very difficult to mix well with other solutions in the cold. Table 4 shows the comparative strength of casein made from the same lots of skim milk with the ejector, acid, and cooked-curd methods.

TABLE 4.—*Comparative strength of skim-milk casein made with ejector, acid, and cooked-curd methods.*

Skim milk.		Times curd washed.	Acidity of drain water.	Drying temperature.	Method.	Casein required.
Lot No.	Portion No.					
			Per cent.	° *F.*		*Grams.*
56.25	25A	1	0.38	130	Sulphuric acid.	9
56.25	25B	4	.10	130	Ejector	8+
56.33	33A	1	.22	130	Sulphuric acid.	9
56.33	33B	4	.00	130	Ejector	8
56.34	34A	1	.14	130	Sulphuric acid.	8
56.34	34B	4	.02	130	Ejector	8
56.59	59A	0	.....	130	Sulphuric acid.	10
56.59	59B	0	.....	130	Cooked curd	9+
56.59	59C	3	.01	130	Ejector	8
56.60	60A	0	.28	128	Cooked curd	9
56.60	60B	0	.....	128	Sulphuric acid.	9
56.60	60C	3	.....	128	Ejector	8
56.61	61A	0	.53	130	Sulphuric acid.	9
56.61	61C	0	.25	130	Cooked curd	9+
56.61	61D	3	.06	130	Ejector	8
56.89	89A	1	.13	124	Sulphuric acid.	8
56.89	89B	1	.10	124	Cooked curd	9
56.89	89C	3	.09	124	Ejector	7+
56.90	90A	3	.04	124	Sulphuric acid.	8
56.90	90B	1	.06	124	Cooked curd	9
56.90	90C	3	.....	124	Ejector	7+

In seven out of eight experiments the wax test showed the ejector-method casein to be the strongest, while in one lot no difference was noticeable. While the difference in strength is not marked in all cases, it shows up with such consistency as to warrant fully the conclusion that the ejector casein is stronger when made under proper conditions. The increased strength of the ejector-method skim-milk casein and its much better working properties make it the most desirable from the standpoint of quality. The ejector method requires more vat capacity, as the skim milk has to be held until it has developed a sufficient degree of acidity to bring about a firm coagu-

lation. The acid and cooked-curd methods have the advantage of requiring less vat capacity, and the casein can be made up in a shorter time.

YIELD OF SKIM-MILK CASEIN.

The yield of skim-milk casein will vary from 2.9 to 3.5 per cent, depending upon the composition of the skim milk, the method of manufacture, and the extent of drying. Because of the better physical condition of the skim-milk curd there is not so much occasion for loss of curd as in the case of buttermilk, and the yield is there-

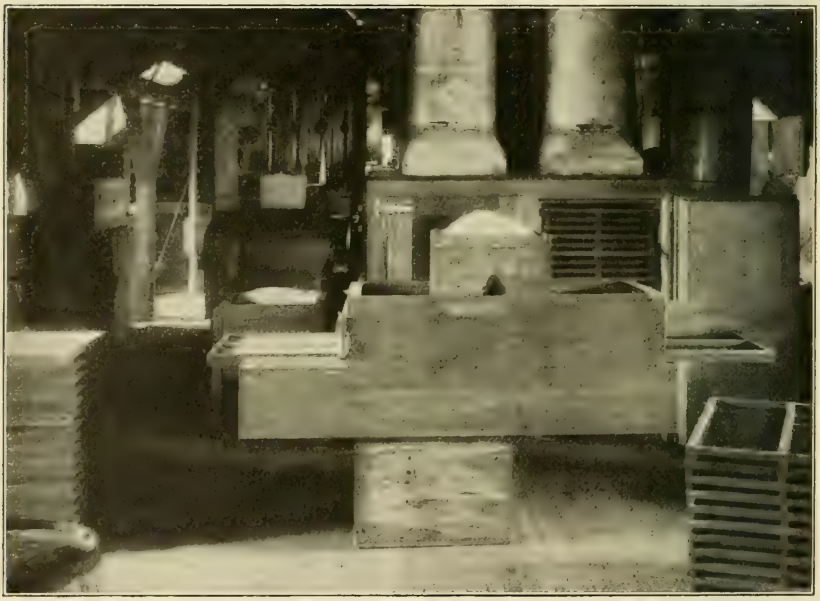

FIG. 9.—By means of a simple shaker screen the ground curd can be spread on the trays in a short time and in a manner giving the most favorable drying conditions.

fore higher. When the skim-milk casein is dried well, so that it does not contain more than from 5 to 7 per cent of moisture, the yield, with skim milk of average composition, ranges between 3 and 3.25 pounds to 100 pounds of skim milk.

REQUIREMENTS FOR GOOD CASEIN.

The practical value of casein depends upon its solubility, adhesiveness, and general working properties. Casein of the desired quality should dissolve within certain limits of alkalinity, giving a clear, uniform solution, free from any scum or sediment, have a fairly heavy body, and possess good adhesive qualities. The general working properties of the dissolved casein, as determined by its vis-

cosity and spreading qualities, must be satisfactory. Any factor that has an influence upon any of the requirements for making a good grade of casein necessarily affects the quality of the product.

The physical condition and chemical composition of skim milk favors the making of a high-grade casein and, provided proper attention is given to the details of manufacture, little difficulty is encountered in making a good grade.

The manufacture of casein from buttermilk, however, presents an entirely different proposition, because of the differences in chemical composition and physical condition of the latter and consequently the increased number of factors which have a direct or indirect influence upon the quality of the casein. The wide variation shown in the quality of buttermilk casein made in the ordinary way indicates clearly the presence of factors influencing its manufacture and having a direct effect upon the quality. A comparison of chemical analysis of normal samples of skim milk and buttermilk shows a higher percentage of fat and lactic acid in the buttermilk, with a decrease in the percentage of lactose equivalent to the increase of lactic acid brought about by fermentation. As fat is undesirable in casein, it is natural to suppose that the increased quantity found in buttermilk would have a marked influence in injuring the quality of the casein. While the difference in fat content may not appear to be so marked in the raw buttermilk, its effect upon the final product will be readily understood when it is considered that the fat in the dried casein is about 33 times that shown by the Babcock butterfat test. The practical creamery method of determining the fat content of buttermilk can not, of course, be regarded as highly accurate, and in consequence it does not always indicate correctly what the fat content of the dried casein will be. In nearly all instances in which buttermilk of a normal fat content was used, the finished casein contained a much higher concentration than the Babcock test of the buttermilk indicated should be present. Table 5 shows the theoretical fat content of the dried casein, based upon the Babcock test for fat in buttermilk and calculated on the basis of the yield in pounds per hundred pounds of buttermilk, compared with the actual fat content of the dried casein as determined by the ether-extraction laboratory method. The figures as a whole do not represent lots of casein made under conditions found requisite to the manufacture of a high-quality product and should not be taken as representative of the analysis of properly made buttermilk casein.

While the increased quantity of lactic acid found in buttermilk may not have in itself any appreciable effect upon the quality of the casein, its presence in combination with one or more of the other influencing factors is very liable to be of considerable importance.

TABLE 5.—*Comparison of calculated and actual fat content of casein.*

Sample No.	Fat content of buttermilk.	Fat content of casein.	
		Calculated.	By ether extraction.
	Per cent.	*Per cent.*	*Per cent.*
56.3	.07	2.31	6.36
56.4	.18	5.94	9.89
56.9B	.20	6.60	23.83
56.10A	.16	5.28	6.31
56.12A	.28	9.24	8.71
56.13A	.89	29.37	21.27
56.14	.015	.495	.93
56.15A	.35	11.55	12.63
56.16B	.60	19.80	14.40
56.17B	.07	2.31	9.67
56.20A	.01	.33	4.29
56.23A	.13	4.29	9.52
56.25A	.04	1.32	3.98
56.30A	.02	.66	7.53
56.35A	.19	6.27	4.18

All analyses of casein samples were made by R. H. Shaw and E. F. Deysher, of the Dairy Division.

Analyses of samples of domestic and foreign skim-milk casein and of buttermilk casein appear in Table 6 and show the difference in chemical composition. The buttermilk samples, made from what would be regarded as the usual run of buttermilk in creameries receiving a good grade of cream, show a marked increase in fat, as was to be expected.

TABLE 6.—*Comparative analyses of skim-milk and buttermilk casein.*

Sample No.	Origin.	Chemical analysis.		
		Moisture.	Fat.	Ash.
		Per cent.	*Per cent.*	*Per cent.*
56.40	Domestic skim milk	7.80	0.60	2.80
56.41	do	8.28	0.93	2.44
56.43	Foreign skim milk	7.95	0.66	1.89
56.44	Domestic skim milk	6.44	1.04	3.69
56.45	French skim milk	8.43	0.75	1.86
56.14	Domestic skim milk	7.74	0.93	1.14
56.10B	Buttermilk	7.65	6.54	0.99
56.22	do	6.68	5.00	1.30
56.23A	do	6.82	9.52	0.60
56.35C	do	5.86	5.62	0.76
56.37	do	6.42	5.82	1.19

METHODS OF DETERMINING QUALITY OF CASEIN.

In order to determine factors having a direct bearing upon the quality of buttermilk casein and the conditions requisite to the manufacture of a product of the best practical value, a study of the solubility, adhesiveness, and general working properties of various lots of casein made under varying conditions was undertaken. Buttermilk from pasteurized sweet cream ripened to an acidity of from 0.40 to 0.65 per cent was used in the investigational work, and no

trouble need be experienced in handling that kind of material. The combination of acid in sour cream with the temperature required for pasteurizing has an injurious effect upon the normal handling of the resulting buttermilk. The degree of acidity which may be present in the cream at the time of pasteurization without seriously interfering with the normal working of the buttermilk curd for making casein has not been determined. As a large proportion of the casein of the best quality is used for coating paper, the numerous lots of casein made were tested with special reference to their adaptability and practical value for that industry. The tests applied in the paper industry, however, give results applicable in determining the value of casein for other purposes for which it may be used. The requirements of casein for high-class paper-coating work are rather severe, and lots not suitable for that work often can be used satisfactorily for other purposes.

The casein is used for the purpose of fixing the coating material to the paper in such manner as to make it a part of the paper. In case an insufficient quantity of casein is used the coating ingredients pull away from the paper when put to the test. By using more casein the coating material is held firmly to the paper, which serves as a practical means of determining the strength of the casein. The strength or adhesiveness of all the samples made was ascertained by a laboratory method used by the paper concerns, in which the quantity of casein required to hold the coating mixture properly is determined.

In addition to the tests made in the laboratory large samples of buttermilk casein were sent to two paper manufacturers for the purpose of having commercial coating tests run on their large machines and in that manner determine its practical value and handling qualities. While the results obtained in the large coating machines did not always indicate the effect of the factor under observation in so marked a degree as was found in the laboratory method, they did demonstrate fully that a good grade of casein suitable for high-class coating and lithographing work can be made from buttermilk.

The strength test was used almost entirely in these experiments as a basis for drawing conclusions as to comparative values of casein in studying the effect of the factor under consideration, as there was no trouble in obtaining a complete solution of the casein after adopting a suitable method. The time required for the casein to dissolve is of importance, but slow dissolving does not necessarily indicate a poor grade, as the rate of dissolving may be influenced by factors that have no effect upon the strength. While the casein must dissolve within a reasonable time, its practical value is determined in the final outcome largely by its strength or ability to hold the coating material.

While the test used in determining the strength of the casein can not be regarded as highly accurate from a scientific standpoint, it is more or less valuable in determining in a practical manner the relative value of different samples of casein. The general handling quality of the different lots of casein was observed during the process of dissolving and also during the actual coating work. Difficulties encountered with the solubility or working properties of the samples, caused by any factor introduced to study its effect upon the quality, will be discussed later under the heading of the particular factor.

ADHESIVE OR STRENGTH TEST.

Fifty grams of casein ground fine enough to pass through a screen with 20 meshes to the inch is weighed into a casserole whose weight is known, 100 cubic centimeters of cold distilled water is added, the two mixed well and allowed to stand for a short time, when 90 cubic centimeters more of distilled water is added in which 5 grams of borax has been dissolved. Distilled water is then added until the mixture weighs 250 grams, and the casserole placed in a water bath having a temperature not to exceed 149° F. (65° C.) and stirred until the casein is dissolved. When the casein is completely dissolved more water must be added to take the place of that lost by evaporation, so that each 5 grams of the solution will represent one of casein. Some samples of casein may require more than the specified quantity of borax or other alkali. No trouble was experienced in dissolving the samples reported in the proportion of borax given.

One hundred grams of china clay or kaolin, previously dried at the temperature of boiling water for one hour, is weighed into a heavy casserole, and 70 cubic centimeters of distilled water added and mixed to a smooth paste, care being taken to work up any lumps that may settle to the bottom. After weighing the casserole with its contents of clay paste, 30 grams of the casein solution, representing 6 grams of casein, is added to it and thoroughly mixed with the paste. A stiff brush is helpful in getting a good mixture. A thin coating of the mixture is then applied to several small sheets of test paper by means of a thin brass scraper or camel's-hair brush, using care to spread uniformly. The casserole is again balanced and 5 additional grams of the casein solution added, the solution well mixed and another set of test sheets coated, continuing the procedure of adding 5 grams of the casein solution and making a set of test sheets until sufficient casein has been added to hold the coating mixture properly to the paper. Best results were obtained by using the brass scraper, which requires that the paper be placed on a perfectly flat surface, such as a piece of smooth plate glass. When using a brush the coating mixture should be painted on very quickly, first lengthwise and then crosswise.

When the sets of test papers having an increase of one gram in casein for each succeeding set are perfectly dry, a short stick of sealing wax softened by heating at one end is applied with a fairly firm pressure to various points where the coating is uniform, and allowed to cool. The paper is then held down firmly by placing the fingers on each side of the wax and the latter pulled away with a steady pull. In case of an insufficient quantity of casein the wax will pull only the clay mixture, but when sufficient casein has been used it will pull the paper fibers strongly to the edge of the wax, showing that the coating material had actually become a part of the paper. Usually a transition point is found when the center of the stick of wax will pull the paper fibers partially, while the next set having 1 gram more of casein will pull all the fibers to the extreme edge of the wax. A good grade of casein should not require more than 8 or 9 grams to hold strongly.

The strength of the casein as shown by this laboratory test bears some direct relation to the quantity of casein necessary to use in the practical coating work, and for that reason was used in determining the influence of the various factors observed upon the strength of the casein.

SOLUBILITY TESTS.

Weigh out 50 grams of air-dried sample ground to pass through a 20-mesh screen, add 300 cubic centimeters of distilled water in which 7.5 grams of commercial borax has been dissolved. Heat in a beaker or other flask in a water bath having a temperature not to exceed 149° F. (65° C.). Complete solution should result within 10 minutes. 149½ F. (65° C.). Complete solution should result within 10 minutes with continuous stirring.

CASEIN MARKETS AND PRICES.

The market for skim-milk casein, which is the only kind that has been made in large quantities in the past, has always been good at the prevailing prices. A few years ago the price received for it was from 5 to 7 cents a pound, but during the last two years, owing to the falling off in the importation, the price has doubled or trebled. At one time the exceptionally high price of 22 cents a pound was offered, with very little available. This price was exceptional, of course, and did not prevail for a great length of time. The demand during the last two years has been steady despite the exceedingly high prices. While the market will readjust itself with a resumption of normal conditions the price, in all probability, will not go back to what it was a few years ago. The large users are frank in admitting that they will not be able again to purchase the product at the former low prices.

The outlet for casein is varied, owing to its large use in so many industries. The largest unlimited market is provided by jobbers who usually buy on contract from the creameries and resell to the consumers. In that way the creamery has a market with the least effort and the consumers can buy standardized lots of casein in quantities suited to their needs. However, by selling direct to the user the creamery can get more money for the casein and the cost to the user is less. Such a method, if it can be arranged properly, is the most satisfactory one for marketing. The development of such a market necessitates the production of a uniform quality of casein in satisfactory quantities.

The price it is possible to obtain depends upon the quality of the casein, market conditions, and the opportunity of making a satisfactory financial deal for the product. The market condition has much to do with the prevailing price. With a scarcity of casein on the market the buyers are willing to pay higher prices and are not nearly so critical as to the quality.

As the value of any casein is determined largely by its strength, the price received for buttermilk casein is less than that from skim milk, for the former is slightly weaker than the best grade of the latter. But with a short market a good grade of buttermilk casein may be sold easily at the ruling price of the skim-milk product.

The Grove City Creamery sells its buttermilk casein direct to the company that uses it at 1 or 2 cents under the prevailing price paid for a good grade of skim-milk casein. The company's chemist stated "The price they would be willing to pay would be governed by the market conditions. With a scarcity of casein the ruling price of skim-milk casein would be gladly paid." The company expressed its preference for the buttermilk casein sent in by the Grove City Creamery over that of some market grades of skim-milk casein.

The method of ascertaining the price paid for the casein in the form of pressed or cooked curd is on the basis of deducting from the market price of the dried casein the cost of transportation and expense of drying.

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BULLETIN No. 662

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

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VESICULAR STOMATITIS OF HORSES AND CATTLE.

By JOHN R. MOHLER,
Chief of the Bureau of Animal Industry.

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HISTORY AND CHARACTERISTICS.

Vesicular stomatitis is known in Europe and South Africa, and has been observed occasionally in sporadic form in the United States, but without attracting any particular attention. During the early fall of 1916, however, it became very extensive in certain sections of this country, being especially prevalent in Nebraska, South Dakota, Colorado, and Wyoming. It was first reported among the horses and mules at remount stations in the Central West, where large numbers of animals had been collected prior to shipment to Europe for use in the French and British Armies. Here the disease found ideal conditions for its spread among thousands of these animals closely quartered in barns and pens. From these remount stations in the Central West the disease became distributed by following the channels of trade from the westward markets eastward as far as the Atlantic coast. The affection did not stop even there, as several shipments were made abroad while the horses were in the incubative stage of the disease, and infected American horses were found shortly after arrival in France.

Strange as it may seem, the first information that this country was experiencing an outbreak of vesicular stomatitis was reported in an article by the French veterinarian Jacoulet, which appeared in the Recueil de Médecine Vétérinaire, December 30, 1915. Owing to the difficulties attending the delivery of these European periodicals since the beginning of the war this copy was not received until several

months later. Jacoulet referred to the erosive stomatitis of indeterminate nature affecting horses coming from America for the French Army. He indicated that some of the veterinarians coming to the army depot were acquainted with this disease, calling it stomatitis of horses and attributing it to the fact that the new horses frequently licked the freshly whitewashed walls near them. The question of etiology was at once referred to the Pasteur Institute, but at that time attempts to carry the disease from horse to horse proved unsuccessful. The opinion was thereupon advanced that defective feed probably of a mycotic nature was responsible, especially since moldiness was quite extensive in American baled hay brought over with the horses.

In the issue of the above-named French journal dated February 29, 1916, Vigel records having observed the disease in question in a large number of American animals. On the basis of his observations he believed that the cause of vesicular stomatitis is a contagion and should not be looked for in the poor quality of hay, as the disease spread to French horses on the surrounding farms and these animals had never eaten American hay. At least one cow became similarly affected. Three bacteriologists of the French Army took samples of blood and vesicular fluid from infected horses, but their results were likewise negative. However, Vigel proved quite clearly that the disease is contagious and transmissible through direct inoculation. More recently, May 15, 1917, Panisset reports in the Revue Générale de Médecine Vétérinaire that vesicular stomatitis had gained considerable ground during the previous few months, but not sufficient to cause any alarm. Particularly those depots that received horses coming from the first infected remount stations have paid heavy tribute to the affection. Although known and described in France before the present war, it had been observed only occasionally and its present frequency there is considered by Panisset to be due to importations of infected American horses for military purposes.

Notwithstanding that the disease primarily affects horses and mules, it may spread to cattle under appropriate conditions, but thus far it has not been observed under natural conditions among hogs and sheep. Evidently the necessary conditions for its spread from horses to cattle obtained in Nebraska, as a shipment of cattle from that locality to the Kansas City Stock Yards in the fall of 1916 was found infected. Much excitement was occasioned thereby, as the disease was quite suggestive of foot-and-mouth disease. However, a series of careful experiments was at once begun, from which the true nature of the disease was ascertained and the diagnosis of vesicular stomatitis made.

Among other more important forms of stomatitis may be mentioned mycotic stomatitis of cattle, which results from eating feed

containing irritating fungi; necrotic stomatitis, especially affecting calves and pigs, which is caused by infection with the necrosis bacillus; stomatitis contagiosa, or foot-and-mouth disease, which is one of the most highly infectious diseases of animals and caused by a filterable virus; and pustular stomatitis, which is less contagious in character than the former and confined solely to the equine.

Concerning vesicular stomatitis, the name not only indicates the location of the lesions in the mouth, but also suggests that the vesicles or blisters are characteristic features, being observed at the beginning of the disease. Other names which have been applied to this affection are sporadic aphthæ, stomatitis vesiculosa, stomatitis aphthosa, erosive stomatitis, sore mouth, "blue tongue," and pseudo foot-and-mouth disease.

ETIOLOGY.

The literature upon the subject of vesicular stomatitis fails to incriminate definitely any specific organism as the cause of this contagion. Repeated cultural studies of fresh vesicular fluid drawn under aseptic precautions from experimentally infected horses and from field cases have resulted in the isolation of a variety of microorganisms including micrococci, several short rod-shaped bacilli, one of which takes the bipolar stain, a large Gram-negative spore-bearing rod, and a fungus. Horses and calves were subjected to inoculations with cultures of these several organisms, both intravenously and by scarification of the epithelial covering of the tongue and inner surface of the lips, but in no instance was the inoculation successful. An inoculation test of a small micrococcus isolated and cultivated under strict anaerobic environment proved it to be innocuous to horses and calves. Finally, fresh vesicular fluid passed through a Berkefeld (N) filter was completely divested of all infectious qualities as determined by inoculation tests of the filtrate in six different experiments.

Microscopic examination of fresh vesicular fluid by dark-field illumination revealed the presence of micrococci and in addition small bodies with refractive coverings which were very similar in appearance to the spores of a fungus isolated on egg medium from a sample taken from a case of vesicular stomatitis.

A bacteriological report of the work done by Dr. George Mathers, of the University of Chicago, on the etiology of this disease was read at the annual meeting of the United States Live Stock Sanitary Association,[1] but the evidence presented in favor of the bacillus described was far from conclusive. Through the courtesy of Dr. James Gregg, of the British remount station at Newport News, Va., several cultures of a microorganism which he had isolated from a

[1] Report of Twentieth Annual Meeting of the United States Live Stock Sanitary Association, December, 1916, p. 33.

case of vesicular stomatitis in a mule and with which suspicious symptoms of the disease were induced in other mules,[1] were obtained for study. With this organism, which proved to be a facultative anaerobe and very slow to develop on any medium, we were unable to infect horses or calves by direct inoculation of large amounts of the culture. Moreover, the employment of this organism, as well as several other different organisms, as an antigen in the complement-fixation test failed to give positive results with sera from either immune horses or immune cattle.

SYMPTOMS AND LESIONS.

The first phenomenon of vesicular stomatitis consists in the formation of reddened patches on the buccal mucosa, especially of the tongue. These are quickly succeeded by vesicles or blisters of grayish-red color only slightly elevated and of various sizes from a dime to a silver dollar, filled with clear or yellowish serous fluid. These blisters may be isolated, but frequently they coalesce to form a large vesicle. They usually rupture in a very short time, which accounts for their not being recognized at times even in the early stages of the disease. The rupture of the vesicles results in exposing the raw underlying surfaces, which appear as reddened erosions with the grayish-white fragments of the torn mucous membrane of the preexisting vesicles still attached to the irregular borders like a fringe. These erosions may become confluent, varying from the size of a dime to that of the palm of the hand, and may even involve practically the entire upper surface of the tongue in horses. Healing varies, but usually occurs quite rapidly in from 8 to 15 days in uncomplicated cases.

While these lesions in horses are principally confined to the upper surface of the tongue, they may involve the inner surface of the lips, the angles of the mouth, and the gums. In cattle, on the other hand, the tongue does not appear to be so extensively affected, and lesions may also occur on the hard palate, lips, and gums, sometimes extending to the muzzle and around the nostrils. Often the lips of the horse are swollen and itchy, which causes the animal to rub the muzzle against any near-by object. In a very few cases fresh cows have shown similar lesions on the teats when their infected calves had been sucking them, but no feet lesions have been observed in these cases.

Immediately before or simultaneously with the appearance of the vesicles there is present a moderate rise of temperature, which rapidly subsides. A more or less profuse flow of saliva follows, which dribbles from the lips and consists of a thin, stringy, or frothy fluid. Not infrequently the presence of salivation is the first indica-

[1] American Journal of Veterinary Medicine, vol. 12, No. 4, April, 1917, p. 221.

tion that the animal is sick. Owing to the painful condition of the mouth at this stage, there is loss of appetite or at least inability to eat, and in horses gritting of the teeth is quite frequent, while in cattle "smacking" noises are heard as in foot-and-mouth disease. This sensitiveness as a rule remains for several days, after which healing commences, and it is remarkable to observe how quickly the sick animals will begin to eat even while their tongues are still eroded. Although eating well, they do not regain their original thrifty appearance for some time longer. In dairy cows in addition to shrinkage in flesh there is a noticeable reduction in the normal flow of milk for a few days.

So far as our observations are concerned, the period of incubation of vesicular stomatitis has varied from 36 hours to 9 days, but the greatest number of cases have occurred in from 2 to 5 days after exposure.

No losses have been reported from uncomplicated cases of this disease in either horses, mules, or cattle. A certain proportion of horses and mules having vesicular stomatitis also became infected with either influenza or contagious pneumonia, or perhaps both, and some deaths have occurred among such animals.

CONTAGIOUSNESS.

That the malady is contagious has been definitely shown by the transmission of the disease from sick to healthy animals by inoculation. The degree of contagiousness, however, varies between wide limits. In fact, certain writers have claimed that it is not contagious, because they fail to reproduce the disease after experimenting with only one healthy animal. Our experience with this disease shows that frequently one or even more of the inoculated animals in an experiment will fail to develop the infection, as in several instances we have produced the disease in only two out of three, or two out of four, or, again, three out of nine of the experimental animals; so that it is necessary to use more than one animal if accurate information is to be obtained. This point is strongly brought out by the opposite conclusions reached by the two French investigators, Jacoulet and Vigel, who recently found the disease in American horses shipped to France. The former believes the disease is benign, nontransmissible, and of alimentary origin, while the latter readily transmitted the disease to other horses and convinced himself of its contagiousness.

Experiments have proved that the disease is most virulent at the time the blisters rupture or shortly thereafter, but when the lesions are five or six days old the virus of the disease has practically disappeared. This may account for the greatly differing results investigators have had in their attempts to transfer the disease artificially. These facts show the necessity of using several experi-

ment animals for inoculation, and also of injecting the infectious material as soon as possible after the blisters have formed.

The virus is evidently of short life, and is transmitted only by close contact. Probably the infected environment remains dangerous longer than the affected animals. At the Bureau of Animal Industry Experiment Station one field was set aside for animals which had recovered from attacks of vesicular stomatitis. Horses and cattle were placed in this field 3 weeks after they first showed symptoms of the disease. Healthy susceptible cattle were kept in this field as a check on the possible spread of the disease, but in no instance did they become infected. Likewise, susceptible animals turned into a stable which 3 weeks previously in one instance, and 16 days previously in another instance, had harbored active cases of vesicular stomatitis, remained well. Several instances have been reported in which a line fence or a board fence in a double corral has been sufficient to prevent transmission of the disease from the infected animals on one side to the healthy animals on the other.

Investigations indicate that the disease is very seldom communicated by owners or caretakers of affected animals visiting other farms. As a rule the disease appears to spread by direct contact with recently affected animals, or by recently infected feed troughs, water troughs, bridles, or pails. Inoculation experiments on such laboratory animals as rabbits, guinea pigs, rats, and mice have resulted negatively. The disease manifests itself in susceptible animals more rapidly after the application of infectious material to scarified areas in the mouth than through intravenous injection, although positive results have been obtained also by the latter method.

Contrary to experiences in the field, we were able in several test inoculations to transmit infection to the feet of cattle in a small proportion of cases, and likewise this virulent material also produced lesions in from five to nine days in the feet of one hog, in the mouth of another, and on the snout of the third. While these cases were the exception and not the rule, they should be recorded for their scientific interest. In this connection it should be stated also that a number of hogs in immediate contact with these animals but without receiving any artificial inoculation remained normal in all cases, while a number of cattle similarly exposed contracted lesions which were confined solely to the mouth. Infectious material expelled from the mouths of attacked animals and kept moist by placing it in a sealed test tube, protected against exposure to light, retained its virulence for three weeks in one instance. Such material after being dried or preserved in normal salt solution lost its virulence in a much shorter period of time.

Very little work appears to have been done on the question of immunity in this disease. A number of horses and cattle which were

typically affected at the bureau experiment station failed to contract the disease when inoculated with the virus three months later, although the control animals became infected promptly. It may be stated that in these cases immunity had persisted for at least three months. Further tests regarding its duration could not be made, because the required infectious material was not obtainable owing to the disease having disappeared. Injections of blood serum from immune animals so far as tested induced no resistance to the disease.

Whether the milk of affected cattle is or is not infectious for people has not been recorded, but such milk has been fed experimentally to hogs without producing any ill effects.

DIFFERENTIAL DIAGNOSIS.

While the disease has not the great economic importance of foot-and-mouth disease, it nevertheless is contagious and causes considerable alarm owing to its close resemblance to the dreaded European disease. Furthermore, as most writers state, this infection in cattle may be readily confounded with foot-and-mouth disease, and experience has shown that a prompt and exact differentiation is accompanied with numerous difficulties. The real difficulties surrounding the diagnosis are best appreciated by those who have faced them with the consciousness that their pronouncement if mistaken would lead on one hand to unnecessary and serious economic disturbances and on the other hand to the spread of one of the most dreaded and easily communicated among animal plagues. Vesicular stomatitis therefore will prove a menace whenever and wherever it may reappear. For these reasons it is strongly urged that local quarantines to prevent its spread be imposed by State live-stock officials in whose territory the disease may be found. All owners and handlers of horses, mules, and cattle, particularly liverymen, managers of stockyards, and stockmen, should be directed to separate sick from well animals, clean and disinfect contaminated premises, and have all infected animals appropriately treated.

The opinion that the malady is not foot-and-mouth disease is based on the fact that persistent observation of sick animals has failed to reveal certain typical symptoms which would be expected in an outbreak of foot-and-mouth disease. The drooling, vesicles, and erosions are similar in appearance to those produced by foot-and-mouth disease, but in none of the animals examined in the field has there been found any soreness of the feet, which is a common symptom of foot-and-mouth disease. Moreover, many horses have this particular ailment, but horses have not been observed to contract foot-and-mouth disease in any of the previous foot-and-mouth outbreaks in the United States. Hundreds of hogs exposed to the disease

and in association with the sick animals in pastures have shown no signs of the malady, which is regarded as significant, because in the last outbreak of foot-and-mouth disease hogs were as susceptible to that disease as were cattle. Exposed sheep also failed to show vesicular stomatitis, yet these cloven-footed animals are susceptible to foot-and-mouth infection. In a number of cases of vesicular stomatitis the lesions appeared to be continuous or progressive, and not explosive, as in foot-and-mouth disease. In these instances secondary lesions were apparent on a number of consecutive days in the mouths of both horses and cattle, and vesicles were observed on the bases of tongues whose free portions were almost denuded of mucous membrane as a result of the rupture of similar vesicles six or seven days before.

Complications are extremely rare in vesicular stomatitis, and neither mammitis nor chronic diseases of the hoof have been observed following it. Sucking calves are seldom affected with the disease, and rarely in other than a mild form, while an attack of foot-and-mouth disease in calves is always serious and not infrequently fatal. The vesicles in foot-and-mouth disease as a rule are larger than in vesicular stomatitis, and are more tightly filled with serous fluid. Furthermore, instead of increasing in virulence by passage through a series of calves, as foot-and-mouth disease has always done in our previous experiments, vesicular stomatitis became greatly reduced in pathogenesis and required a constantly increasing period of incubation before manifesting lesions of the disease. Although numerous filtrate experiments have been conducted, in no case has the disease been reproduced in this manner, which is also unlike our experiments with foot-and-mouth disease.

The percentage of animals infected in each of the herds of cattle, and the history of exposure without transmission of the disease except by immediate contact, would indicate that this ailment is not the highly contagious foot-and-mouth disease which, once it is introduced into a herd, quickly affects practically 100 per cent of the cattle and hogs on all the farms to which the virus may be carried by intermediate agencies.

The result of this study of vesicular stomatitis suggests the necessity of inoculating horses with suspected material in any future outbreak of disease bearing a resemblance to foot-and-mouth disease.

Finally, it must be apparent that in vesicular stomatitis we have a disease more closely resembling foot-and-mouth disease than either mycotic or necrotic stomatitis, and that Hutyra and Marek are correct in their opinion that a reliable differential diagnosis can be made only after inoculation experiments and careful observation lasting a number of days.

TONGUE OF HORSE AFFECTED WITH VESICULAR STOMATITIS, SHOWING LESIONS IN THE MIDDLE AND ON THE TIP FROM WHICH THE MUCOUS MEMBRANE HAS BEEN REMOVED.

In mycotic stomatitis portions of the lining membrane of the mouth become inflamed, and in a few days it changes to a croupous membrane which peels off leaving a raw surface, while the thin skin between the toes may also be inflamed. Swelling of the feet and stiffness of the animal are frequently evident in mycotic stomatitis. The previous history of the case, the absence of its spread to horses exposed to the infection, and the complete negative results obtained by the inoculation of calves, distinguish between this disease and vesicular stomatitis. Lastly, mycotic stomatitis occurs in only from 10 to 15 per cent of the cattle in a herd, usually late in the summer or early in the fall after a dry spell, and it does not run a regular course.

Necrotic stomatitis may be distinguished from vesicular stomatitis by the fact that while it affects cattle and especially calves, it may also involve pigs and sheep, but its spread among the animals of a herd shows a much lower degree of infectiousness than vesicular stomatitis. The characteristic lesion of the latter is the appearance of blisters containing a serous fluid on the mucous membrane of the mouths of the affected animals. In necrotic stomatitis blisters are never formed, destruction of the tissues occurring from the beginning and being followed by the formation of yellowish, cheesy patches principally found involving the lining membrane of the mouth, especially the tongue and cheeks. The cause is the *Bacillus necrophorus*.

In horses vesicular stomatitis must be differentiated from contagious pustular stomatitis, and this is not difficult. In the latter disease there are no simple erosions, but instead there are raised nodules on the mucous membrane of the mouth. These nodules suppurate and liquefy in the center, causing the conical surfaces to slough, resulting in the formation of pustules or ulcers, from which the name of the disease is derived. The location of the nodules and pustules is chiefly on the lips, gums, inside of the cheek, and on the tip and sides of the tongue. While the disease may be transmitted artificially to cattle, sheep, and hogs, it occurs under natural conditions only among equines.

TREATMENT.

The treatment of vesicular stomatitis consists in first removing the affected from the healthy animals and isolating the former until fully recovered. Such isolation together with the adoption of rigid sanitary precautions greatly reduces the prevalence of the disease. If the animals are gentle enough to be handled, one-half tablespoonful of borax should be placed on the tongue twice daily, or the mouth syringed several times a day with a 1 per cent solution of

permanganate of potassium; otherwise 2 heaping tablespoonfuls of borax or 1 tablespoonful of potassium chlorate should be dissolved in a bucket of water and the affected animals allowed to drink or rinse their mouths with this medicated water at their pleasure. Hay should not be fed for the first few days, but instead bran or other soft feed should be given. If the animals are treated in this manner and carefully fed, the disease should rapidly disappear.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 663

Contribution from the Bureau of Chemistry
CARL L. ALSBERG, Chief

Washington, D. C. PROFESSIONAL PAPER May 27, 1918

THE INSTALLATION AND EQUIPMENT OF AN EGG-BREAKING PLANT.

By M. K. JENKINS, *Assistant Bacteriologist*, prepared under the direction of M. E. PENNINGTON, *Chief, Food Research Laboratory.*

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PURPOSE OF THE INVESTIGATION.

To assist egg breakers to select effective apparatus and to arrange their plants to handle liquid egg in a sanitary manner and with maximum economy of space and labor is the purpose of this bulletin. The essentials for successful egg breaking are sanitary quarters, excellent lighting, proper ventilation, well-designed apparatus, facilities for quick freezing of liquid egg, and, of course, trained operatives.

The thoroughly modern plant must provide a chill room for the eggs in the shell, a chilled candling room, a refrigerated breaking room in which the egg contents are removed from the shell, a room in which to wash and sterilize apparatus used in breaking, and a sharp freezer for the quick freezing of the liquid egg and its storage. Economy in handling eggs demands that proper space be allotted to the several departments, and that each be so located with reference to the others that unnecessary walking and trucking are avoided. The egg-breaking room and that for cleansing the apparatus are of peculiar importance. On these subjects this bulletin gives conclusions based upon a special study of frozen and dried eggs. It recommends certain improvements in the distribution of space, and discusses new equipment devised to meet special requirements of the industry. To assist the egg breaker who wishes to improve his

plant, floor plans are offered, and the construction of egg-breaking and sterilizing rooms, as well as that of the various pieces of apparatus, is described in detail.

CONSTRUCTION AND ARRANGEMENT OF ROOMS.

An abundant supply of natural light is the first essential in successful egg breaking. Serious faults may be expected in a product prepared other than in full daylight. For this reason the actual egg breaking should be done, if possible, in a corner room, as opened eggs can not be graded accurately by artificial light. The room where the utensils are washed and sterilized also should have natural lighting. Well-lighted, up-to-date breaking and sterilizing rooms are shown in Plate I.

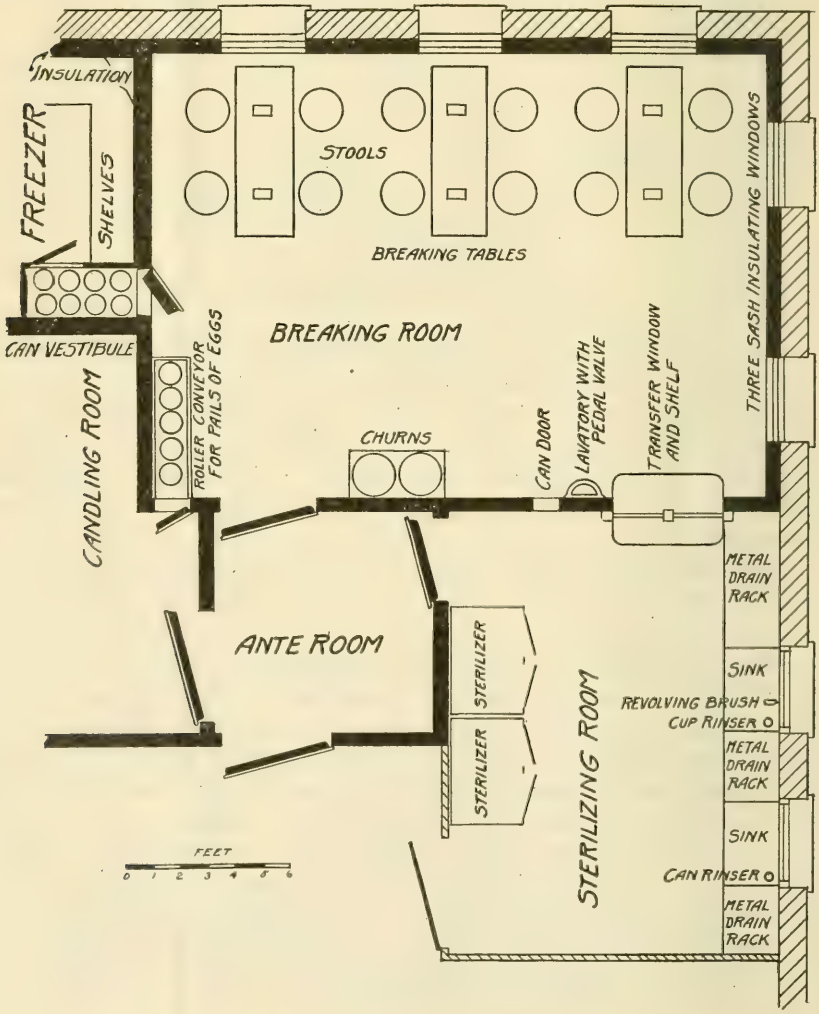

FIG. 1.—Typical layout of breaking and sterilizing rooms.

To avoid unnecessary walking and trucking, the various rooms should be placed as compactly as possible. The plan shown in figure 1, which provides space for 12 breakers, and has a daily capacity up to 120 cases, when whites and yolks are packed separately, or up to 180 cases, when eggs are packed whole, has proven satisfactory. In such an establishment a trained breaker may be expected to open from 12 to 15 cases a day when preparing whole eggs, and from 8 to 10 if whites and yolks are kept separate. The sterilizing room shown accommodates two workers at a time. The vestibule or anteroom has been found a distinct economy, because it saves refrigeration, and at the same time protects the important breaking room from the dust of the more frequented space beyond. Although this plan can not be followed rigidly in all plants, slight modifications doubtless being necessary to meet varying conditions, the ideal arrangement and equipment should suggest many readily effected improvements, and afford a practicable standard by which egg breakers can measure the efficiency of their establishments.

Those who wish larger egg-breaking rooms can increase the overall dimensions, but they should allow 5 feet for the center aisles between the tables and 3 feet between the tables and walls. The unit tables for two girls are 2 feet wide and 3 feet long, although these may be lengthened to seat the number of breakers desired. In any rearrangement of the plan, however, the egg-breaking and sterilizing rooms should not be separated. For convenience the candling room should connect with the breaking room, which can be accomplished by placing it next to or above the breaking room. The freezer, whenever possible, should be located next to the breaking room.

The general requirements of construction of the different rooms are given in Table 1.

TABLE 1.—*General requirements of construction of the rooms of an egg-breaking plant.*

Room.	Cork insulation (or its equivalent) in walls and floor.	Temperatures to be maintained.	Wall finish.	Floor.	Windows.
	Inches.	° *F.*			
Chill room	4	32 to 40	Plastered to smooth finish.	Concrete or wood.	Not required.
Candling room	2	50 to 55	do	do	Do.
Breaking room	2	60 to 65	Plastered and white enameled.	Concrete with drain.	Essential.
Freezer	6	0 to 10	Plastered to smooth finish.	Concrete or wood.	Not required.
Sterilizing room.	None.	Room temperature.	Plastered and white enameled.	Concrete with drain.	Essential.

The windows in the breaking room should be treble paned for insulation. Prism glass is frequently used for the outer panes in order to distribute the light more evenly.

The freezer should be equipped with shelves of piping through which brine is circulated for freezing the cans of liquid egg (Pl. II, fig. 1). For accommodating two rows of cans of 30 pounds capacity, these shelves should be about 20 inches wide and about 15 inches apart. Such brine pipe shelves may be used as a "sharp freezer," while the body of the room, which can be maintained at about 10° F., may be used for holding.

TRANSFER OPENINGS AND CONVEYORS.

TRANSFER OF SHELL EGGS.

Trucks ordinarily are used for moving cases of eggs from the receiving floor to the chillroom and thence to the candling room. If the candling room adjoins the breaking room, it is convenient to use a roller conveyor (fig. 1) for transferring the candled eggs in pails to the breaking room. If the space is not suited to a conveyor, the pails of eggs may be pushed by hand on a metal-covered slide through a small door into the breaking room (fig. 2). When the candling room is above or below the breaking room, the pails of shell eggs may be moved by means of a chain conveyor of the type shown in Plate II, figure 2. If the breaking and candling rooms do not adjoin, it is usually less expensive to use trucks for moving the eggs. The taking of trucks into the breaking room should be obviated, however, whenever possible, because the wheels are carriers of dirt and dust.

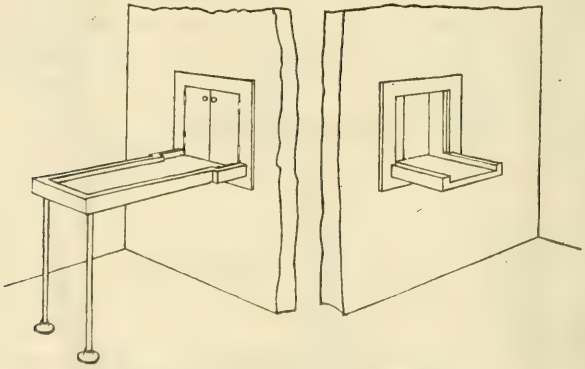

FIG. 2.—Chute for transferring shell eggs.

TRANSFER OF LIQUID EGG.

The prompt transference of the liquid egg from the breaking room to the freezer is important. If the breaking room and freezer adjoin, this may be accomplished very conveniently by means of a small refrigerator door, about 2 feet square and 3 feet from the floor, leading to a vestibule, 2 feet wide by 2 feet high and several feet long, with a door in the side or in the opposite end. The floor

of the vestibule should be covered with galvanized iron or other metal to permit easy cleaning. By this arrangement, the filled cans as soon as weighed may be placed in the can vestibule and later removed from the freezer side, resulting in a saving of refrigeration and labor (fig. 1). If the breaking room and freezer are not adjoining, trucks are ordinarily used for moving the cans of liquid egg. If the plant is large enough to justify the expense of installing the chain conveyor, it may be modified by using trays instead of hooks for carrying both the pails of shell eggs and cans of liquid egg from one floor to the next.

TRANSFER OF EQUIPMENT FOR WASHING.

A sliding insulated window (figs. 1 and 3) has been found almost indispensable for transferring small equipment between the breaking and sterilizing rooms. The detail plans for its construction are

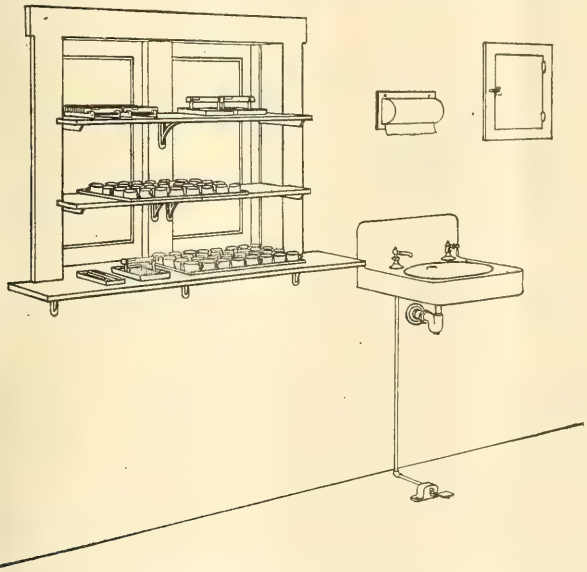

FIG. 3.—Section of wall of breaking room showing transfer window, can door, roll of paper towels, and sink with pedal valve attachment.

given in figure 4. The weight boxes should be built on the sterilizing room side of the wall. On the breaking room side of the window shelves may be erected to hold a supply of small equipment, such as cups, knives, and breaking trays for immediate use by the breakers. Clean utensils are kept on the two upper shelves, and soiled utensils only on the bottom shelf. The equal division of the middle shelf, so that one-half may be removed, makes it possible to deliver larger apparatus, such as cans and pails, to the sterilizing room and vice versa.

With such a window, the breakers may secure individual pieces of equipment as needed, and the operator in the washroom may

remove a tray full of equipment for cleaning with one raising of the window. Large apparatus, such as shell cans, which are cleaned only at night, are carried through the anteroom into the sterilizing room. A small door (fig. 3) may be used for passing sterilized cans into the breaking room.

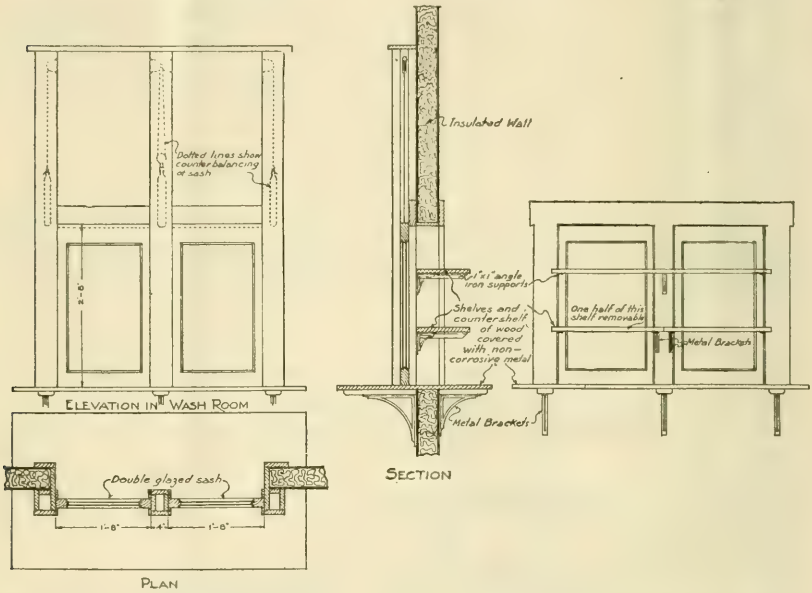

FIG. 4.—Detail of transfer window between breaking and sterilizing rooms. Be sure to build the weight boxes on the sterilizing room side of the partition.

VENTILATION.

The candling and breaking rooms should be furnished with a supply of fresh, dry air. If the plant is located where the humidity is comparatively low, a stream of fresh air can be forced into the rooms through several layers of cheesecloth, by means of a suction fan. The ideal method is the bunker system by means of which the air is cooled on bunker coils and admitted through pipes into the breaking and candling rooms. When this method is the only source of refrigeration for the rooms, care should be taken that the bunker room is of adequate size to provide sufficient refrigeration during the warm summer weather.

In small candling and breaking rooms refrigerated with brine coils, an electric fan is usually sufficient to keep the air fresh, especially if the doors are opened frequently for the admission or transmission of material. The difference in temperatures within and without causes a rapid change of air.

EQUIPMENT OF BREAKING AND STERILIZING ROOMS.

The equipment of an egg-breaking plant, like that of creameries, must be so made that it is readily cleaned, and from materials which will not rust or tarnish easily. Although some of the apparatus required may be purchased ready made on the market, a number of pieces, which have been specially developed for egg-breaking work, at the present time must be made to order.

OUTFIT LIST.

Table 2 gives an outfit list to serve as a guide in ordering equipment for egg-breaking and sterilizing rooms.

TABLE 2.—*Outfit list for egg-breaking plants.*

Item.	Sold or made by—	Number required.	Figure No.	Description.
EQUIPMENT PURCHASABLE ON THE MARKET.				
Breaking room:				Page.
Pails for eggs	Hardware firms	3 to 6 per breaker	5	8
Pails for liquid product	do	1½ per breaker		15
Leaker trays	Special tinning firms	3 per candler	7	8
Separators	Special manufacturers	2 per breaker	Pl. I	11
Glass cups	House-furnishing stores	12 per breaker	8	9
Storage cans for shells	do	See page 14		14
Holders for toilet paper	do	1 per breaker		16
Rack for paper towels	do	1 per room	3	16
Spoons	do	1½ per breaker		10
Stools—				
In wood	do	1 per breaker	15	15
In iron	Hospital-supply firms			
Lavatory with pedal-valve attachment	Plumbing-supply firms	1 per room	3	16
Scales	Scale manufacturers	1 per churn and 1 for whites.		19
Cans	Can manufacturers	According to output	Pl. II	20
Refrigerated churn	Dairy-supply firms	See page 17	Pl. I	17
Dasher for hand churning	do	See page 19		19
Uniform for men	do	3 per worker		19
Waterproof apron	do	1 for each operator in wash room.		19
Sterilizing room:				
Sinks	do	See page 21	21	20
Sterilizers	do	See page 23	24	23
Cup rinser	do	See page 21	22	22
Can rinser	do	See page 22	23	22
Cup-washing machine	do	See page 20	21	20
EQUIPMENT MADE TO ORDER.				
Breaking room:				
False bottoms for pails for shell eggs.	Tinner	1 for each pail for shell eggs.	5	8
Breaking trays	Tinner and machinist	1½ per breaker	9	10
Breaking knives	Machinist	6 per breaker	9	12
Uniforms for women	Seamstress	3 per worker	Pl. I	19
Breaking table	Tinner	1 unit table per 2 breakers.	11	12
Funnels	do	1 per unit table	12	13
Shell cans	do	1 per unit table; few additional.	13	14
Shell tampers—				
Small	do	1 per breaker	14	14
Large	do	1 to 2 per room		14
Cup trays	do	1 per 24 cups	16	15
Knife racks	Machinist or tinner	1 per 36 knives	17	16
Churn without refrigeration	Tinner	See page 17	18, 19, 20	17
Sterilizing room:				
Draining racks for sink	do	See page 21	21	21

BREAKING ROOM EQUIPMENT.

PAIL FOR SHELL EGGS.

(Fig. 5.)

Because cases with their accompanying fillers, flats, and excelsior carry litter and dust, the eggs should be transferred to metal containers before being taken to the breaking room. Ordinary pails

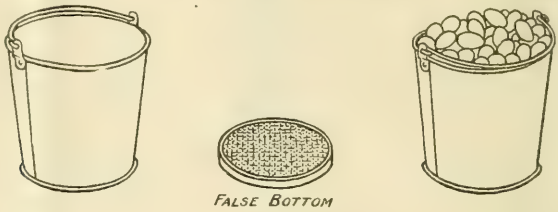

FIG. 5.—Pail for shell eggs.

holding from 12 to 15 dozen eggs have been found very satisfactory for this purpose. When filled they are not too heavy for the girls to lift upon the breaking tables. These tables are made so that two pails may be placed side by side at each end, one for the unopened eggs and the other for the liquid product (fig. 6). By this arrangement each of the two girls working opposite one another has an individual supply of eggs at her right, so that both can work from right to left. When one large container is used by two operators, it is necessary for one of them to pick up each egg with her left hand and pass it to the right hand for cracking on the knife. This extra movement may be avoided by the use of individual pails for holding the breaking stock. To prevent the lower layers of eggs from becoming soiled with the leakage from damaged eggs, a false bottom is placed in each pail.

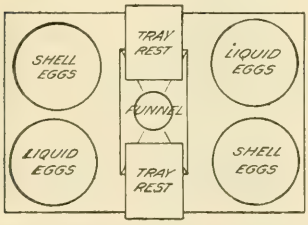

FIG. 6.—Diagram showing position of utensils on breaking table.

Satisfactory pails may be made of galvanized iron 0.0159[1] inch thick with a wire 0.1144[2] inch in diameter in the top, and with a heavy iron bail riveted to the sides. Tinplated iron or copper pails may be obtained if desired. Pails holding from 12 to 15 quarts are ordinarily used. The false bottom is made usually of galvanized iron cloth of $\frac{3}{8}$-inch mesh, soldered neatly to a rim of galvanized iron 0.0159 inch thick. It is $\frac{3}{4}$ inch high, with a diameter $\frac{1}{8}$ inch less than the diameter of the pail.

NESTING LEAKER TRAY.

(Fig. 7.)

Leaking eggs which are sufficiently well preserved to be used for breaking stock should be sent to the breaking room in trays. If made

[1] Equivalent to No. 26 Brown & Sharpe gauge. [2] Equivalent to No. 9 Brown & Sharpe gauge.

to nest much time and space in the handling will be saved. The eggs are placed by the candlers in the holes, with the leaking end at the top.[1]

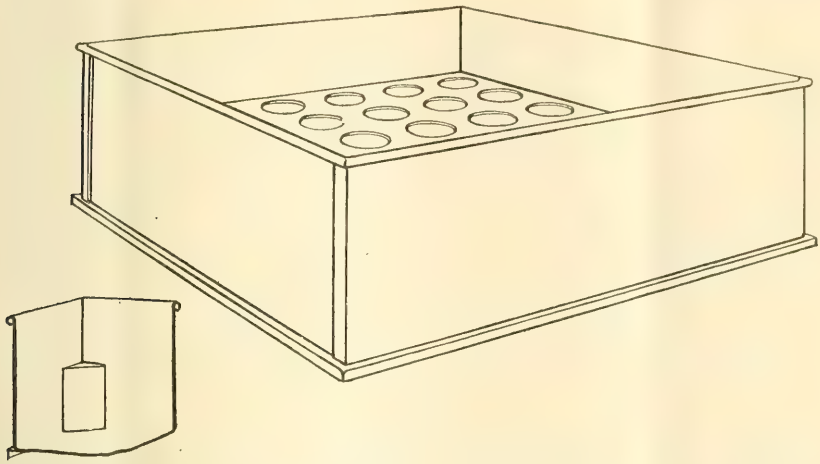

FIG. 7.—A nesting tray for leaking eggs (capacity, 3 dozen eggs).

Specifications.—The tray, which is usually made to hold three dozen eggs, consists of a pan and a perforated plate for holding the eggs. The pan is made of galvanized iron 0.0159 inch thick, and is 12¼ inches square and 3½ inches high, with the rim rolled on wire 0.1144 inch in diameter. The plate for holding the eggs, made of galvanized iron 0.0201 inch thick,[2] has 36 perforations, 1⅜ inches in diameter, with centers 2 inches apart and ⅜ inch from the edge. The plate is supported upon triangular posts of metal or solder 1½ inches high and 1½ inches on the face of the sides and the top. A flange ¼ inch in width is soldered to the bottom, so that it fits over the top of another tray for nesting.

GLASS GRADING CUP.

(Fig. 8.)

Glass cups should always be used for the grading of eggs as they are broken from the shell. Certain kinds of bad eggs, such as eggs with green whites, frequently escape detection when opened into nontransparent cups. The cup should have heavy walls and be made of smooth, clear white glass, which will stand repeated sterilization with steam, and should hold about one-half a gill. A cup of this size will hold two eggs conveniently. More than two eggs should not be broken into the first container for grading. Some plants break only one egg to the cup before emptying, so that all loss of good eggs from contamination with bad eggs is avoided. A plain

[1] The details of the handling and grading of leaking eggs are discussed in U. S. Dept. Agr. Bul. 224, pp. 9 to 12, inclusive.

[2] Equivalent to No. 24 Brown & Sharpe gauge.

glass sherbet cup with a large handle, which may be purchased from house-furnishing stores, has proven very satisfactory for this purpose.

FIG. 8.—Glass grading cup.

The type of support for the cups in some breaking trays requires a cup with a "tumbler bottom," the walls of which are not curved toward the base as in a sherbet cup. Such cups must be made on a special mold. They have not proven satisfactory because the glass furnished in filling these small private orders is so brittle that it does not withstand the heat of sterilization. For this reason it is best to choose a breaking tray on which the glass cups already available on the market may be used.

SPOONS.

When breaking eggs, spoons are needed to remove pieces of shell and portions of yolk from white when separating. Cheap spoons of aluminum or tin may be used. Nickel-plated bouillon spoons have also been found very convenient for this purpose.

BREAKING TRAY.

(Fig. 9.)

The breaking tray should measure 9 by 10 by $1\frac{1}{2}$ inches (inside measurements), and be made of tinned copper 0.0188 inch thick,[1] or monel metal 0.0201 inch thick. As monel metal does not rust or tarnish, it is much to be preferred for this piece of equipment. For firmness, the edges are turned over wire 0.1144 inch in diameter which will not rust. The corners are full soldered and smoothed.

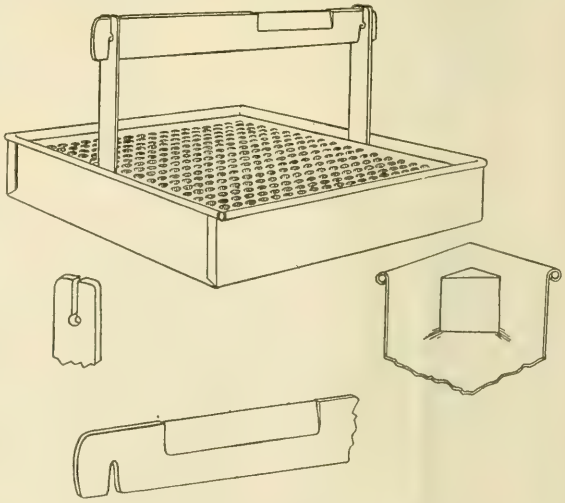

FIG. 9.—Egg-breaking tray and knife.

The standards for holding the knife are $\frac{3}{4}$ by $\frac{3}{32}$ by $4\frac{3}{8}$ inches, extending $3\frac{5}{8}$ inches above the tray, and both soldered and riveted to the short sides. The slots in the standard

[1] Equivalent to 14 ounces per square foot.

are $\frac{5}{8}$ inch deep by $\frac{3}{32}$ inch wide. The knife must be easily removable from the slots and at the same time rest firmly; otherwise the bowl of the separator for whites and yolks will not rest in a level position when sliding on the breaking knife. The separator ordinarily used is patented and can be purchased on the market.

To keep the bottom of the breaking cups from coming in contact with the drip from the eggs, the cups are held on an open support. The following are some of the types of supports used:

1. Galvanized-iron wire cloth of $\frac{1}{2}$-inch mesh, with edges turned neatly over galvanized-iron wire 0.1144 inch in diameter. This rack is supported at the corners of the tray by posts of solder or metal (fig. 9). To keep the cups from slipping, the rack should rest $\frac{3}{8}$ inch below the top of the tray. This rack is easily made, but is not as easy to clean as Types 2 and 3. Nor does it carry off the drip as effectively as Type 3.

2. Monel metal 0.0201 inch thick or tinned copper plate 0.0188 inch thick, perforated with holes $\frac{3}{8}$ inch in diameter, separated by a wall $\frac{1}{8}$ inch wide, with outside row of holes $\frac{1}{2}$ inch from the edge (fig. 9). This is supported upon posts at the corner of the tray just like the wire rack already described. The drip does not drain from this support as well as from Type 2. It is easily cleaned.

3. An aluminum rack consisting of parallel rods $\frac{1}{4}$ inch in diameter, riveted $\frac{1}{2}$ inch apart to flat end pieces $\frac{1}{2}$ inch wide by $\frac{3}{16}$ inch thick. This rack, made to fit loosely in the tray, rests like the others on supports in the corners of the tray. This support is very satisfactory, because it keeps the bottom of the cups free from drip and is easy to clean.

Other efficient devices for supporting the cups above the bottom of the tray have been developed by individual firms. As some of these are patented and others are not easily made with the ordinary machinery, they will not be described here.

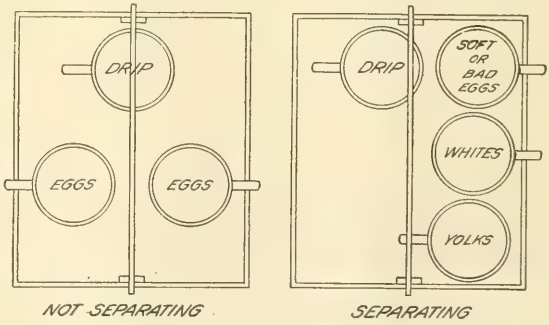

FIG. 10.—Diagram showing position of cups on breaking tray.

The position of the cups on the tray is shown in figure 10. If desired, the standards may be placed $2\frac{1}{2}$ inches from the corners of the tray, in which case the two grading cups are placed on the right-hand side of the knife, whether separating white and yolk or not. The cup, emptied with the left hand, is removed from the tray by pulling under the knife.

BREAKING KNIFE.

(Fig. 9.)

The breaking knife is constructed to fit the tray just described. It is $11\frac{3}{8}$ inches long, 1 inch wide, and $\frac{1}{16}$ inch thick. The slots on the lower edge are $\frac{9}{16}$ inch deep and are made to fit into the slots of the standard. The cutting edge of the knife is $2\frac{3}{8}$ inches long and $\frac{3}{4}$ inch from the center of the slot. The only satisfactory metals for breaking knives are monel metal and tinned brass, as cheaper metals invariably rust and tarnish, so that the expense of scouring and retinning soon equals the original cost of monel metal or brass.

BREAKING TABLE.

(Fig. 11.)

Tables are made for two, four, six, and sometimes eight operators. The size of the table depends upon the space in which it is to be

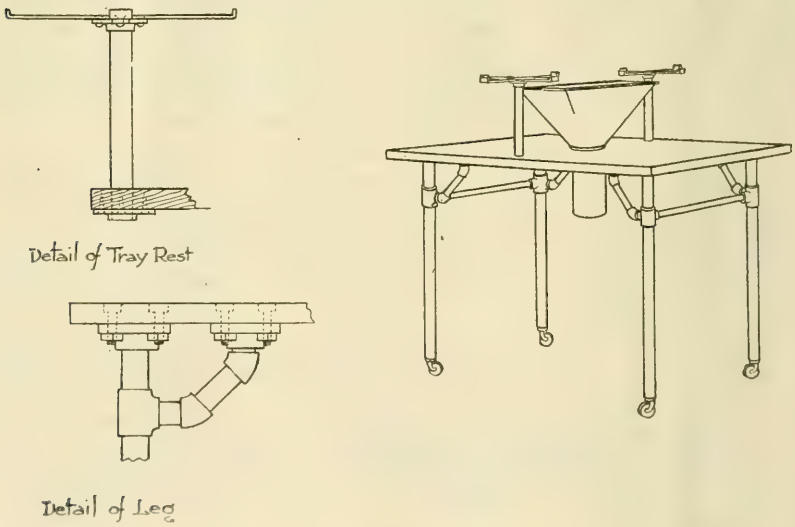

FIG. 11.—Breaking table.

used. Generally speaking, tables seating from two to four girls are most convenient, because the pails of shell eggs, liquid egg, and shells may be removed by helpers at the ends of the tables without interrupting the work of the breakers. A table for two girls, which may be lengthened according to the capacity desired, using the distance from center to center of the legs as a unit, may be made as follows:

Specifications.—The top of the table is 36 inches long and 24 inches wide, with a central opening $5\frac{1}{2}$ inches in diameter to receive the funnel. The kind of top depends upon the materials

available and individual preferences. It may be made of $\frac{7}{8}$-inch pine boards battened on the under side and covered neatly with zinc 0.0201 inch thick,[1] tin or nickel-plated copper 0.0188 inch thick, or monel metal 0.0201 inch thick. The lower side of the table may be covered with the metal also, if desired. Boiler iron $\frac{1}{4}$ inch thick, which may be painted with white enamel, or iron on which the enamel has been applied by a baking process, is also used for table tops without a foundation of wood. The enamel in each case chips, so that it must be renewed every season. Sometimes heavy galvanized iron is riveted at the edges to an angle iron frame and used without the wood support. Occasionally white glass, cemented into an angle iron frame, is used for a table top. The sides of the central opening for the funnels should, in this case, be lined with metal to prevent chipping.

The legs are made of 1-inch and the braces and crosspieces of $\frac{3}{4}$-inch galvanized iron pipes (inside measurements). They are fastened to the table by means of flanges, using square-headed bolts countersunk in the wood before the metal covering is laid. In tops without wood, flat-headed bolts countersunk in the metal are used. The center of the top of each leg should be 3 inches away from the edge of the table. Angle iron legs bolted at the corners to the angle iron frames are used for tables having glass tops. The legs should be furnished with a roller or ball castor 1 inch in diameter. Tables made for more than four girls require central supporting legs which should be braced on both sides and connected with crosspieces.

The tray rest is mounted on a galvanized iron pipe or nickel-plated brass tubing 8 inches long and $\frac{3}{4}$ inch in diameter (outside measurements), which passes through the table into a pipe flange screwed to the under side of the table. The metal covering of the table is soldered to the pipe. The tray rest may be made of two pieces of $\frac{3}{16}$-inch by 1-inch bar iron welded together at right angles at the center, with the ends turned up $\frac{1}{4}$ inch. The two arms are made to receive the breaking tray, the distance between the turned-up ends being 10 inches on the arm parallel with the short side of the table and 9 inches on the other arm. Countersunk flat rivets are used to fasten the arms to a pipe flange connected at the top of the pipe support. If preferred, the tray rest may be made of metal cut in the shape of a diamond, with the corners turned up to hold the breaking tray in position. Circular rests are also used.

SHELL FUNNEL.

(Figs. 11 and 12.)

The shell funnel fits loosely in an opening in the center of the breaking table, in front of the rests for holding the breaking trays.

[1] Equivalent to No. 10 sheet zinc gauge.

The shells are dropped by the breaker through the funnel into the shell can beneath.

Specifications.—The funnel may be made of tinned copper 0.0188 inch thick, zinc, monel metal, or galvanized iron 0.0201 inch thick. The top of the funnel is 8½ inches wide and 14¾ inches long. The distance from the top of the spout to the top of the funnel is 6 inches. The spout is 7 inches long and 5⅜ inches in diameter. Both the top and bottom of the funnel should be rolled on wire 0.1144 inch in diameter.

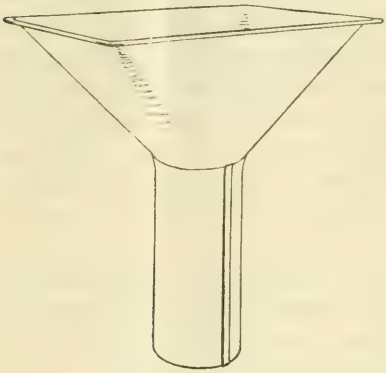

FIG. 12.—Shell funnel.

SHELL CAN.

(Fig. 13.)

It is advisable to make the shell can as large as the dimensions of the table will permit, in order to lessen the frequency of the removal of shells. When there is but little space between the top of the can and the lower side of the top of the table, the scattering of shells on the floor is also prevented.

Specifications.—The shell can is usually made of galvanized iron, and need not be corrugated horizontally for stiffness unless under 0.0159 inch in thickness. Both the top and the bottom should be turned over wire 0.162 inch thick. The diameter of the can is 14 inches; the height 23½ inches, ½ inch less than the distance from the floor to the lower side of the table top. Ordinary garbage cans may be purchased for the temporary storage of shells emptied from the cans from the breaking room, the number required depending upon the frequency of emptying.

FIG. 13.—Shell can.

SHELL TAMPER.

(Fig. 14.)

FIG. 14.—Shell tamper.

A tamper is always needed for pounding down the shells emptied into the storage cans, and may be used to advantage in the shell cans at the table. When used at the table, a tamper is kept in each shell can with the handle projecting through the funnel.

Specifications.—The total length is 34 inches. An iron bar ¾ inch in diameter constitutes the handle. If the tamper is to be used in the storage cans, the cone may be made 7¼ inches high and 5½ inches in diameter at the base, or, if used in the shell cans at the table, 6 inches high and 5

inches in diameter. If desired, the iron bar may be made long enough to have a handle, which is 5 inches wide and $5\frac{3}{4}$ inches long, bent on one end and similar to that shown in figure 14. The cone is made of galvanized iron 0.0201 inch thick, or tinned copper 0.0188 inch thick. The cone is filled with sand, cement, or melted lead, the handle inserted, and the top of the cone smooth soldered to the handle.

STOOL.

(Fig. 15.)

Comfortable stools adjustable in height should be provided for the breakers. These may be purchased in wood from house-furnishing stores, or in steel covered with white enamel from hospital-supply firms. The white-enamel stools, although more expensive, are more sanitary. If purchased in wood they should be ordered unvarnished, so that they may be finished with white enamel.

Specifications.—The stool used with the egg-breaking table should be adjustable from $16\frac{1}{2}$ inches to $23\frac{1}{2}$ inches in height. The diameter of the seat and the distance between the feet at the base should be about 13 inches.

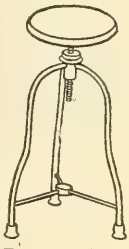

FIG. 15.—Stool with adjustable seat.

PAIL FOR LIQUID PRODUCT.

In many egg-breaking plants new sterilized cans are used on the breaking tables to receive the liquid product. After one-half day's service they are cleaned and used as final containers for the liquid egg, new cans taking their places at the tables. In some houses small pails with handles are used, because they are more convenient to remove from the tables and because less spoilage occurs if a breaker by accident fails to detect a musty egg.

Specifications.—The pail should be made of tinned iron or copper 0.0159 inch thick, and should have a heavy iron bail riveted to the sides. All seams should be full soldered to permit easy cleaning. Pails holding 5 to 10 quarts are ordinarily used.

CUP TRAY.

(Fig. 16.)

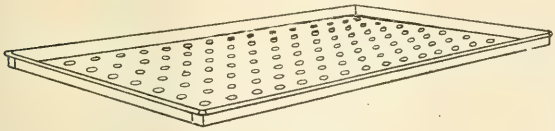

FIG. 16.—Cup tray.

While cups are draining and being sterilized they may be conveniently handled on trays. It is advisable that the bottoms of the trays be perforated so that the water may drain off. The little rim prevents breakage.

Specifications.—Cup trays are usually made of galvanized iron 0.0159 inch thick. Monel metal is sometimes used. The size of the

tray is 1 foot wide, 2 feet long, with sides $\frac{1}{2}$ inch high, turned over wire 0.1144 inch in diameter. The bottom is perforated with $\frac{1}{2}$-inch holes with centers $\frac{1}{2}$ inch apart.

KNIFE RACK.

(Fig. 17.)

Knife racks hold the supply of breaking knives while draining, during sterilization, and before use by the breakers. Racks with a capacity of 18 knives have been found most convenient.

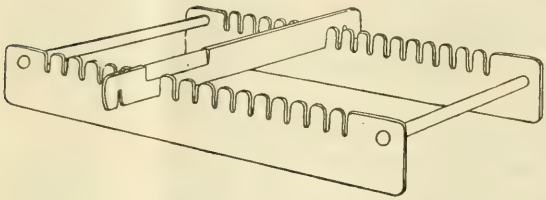

FIG. 17.—Knife rack.

Specifications.—The knife rack is made of two pieces of metal, $1\frac{3}{4}$ inches wide and $11\frac{1}{2}$ inches long, held together by an iron rod $\frac{3}{8}$ inch in diameter and $7\frac{1}{4}$ inches long, riveted at the ends. The slots for the knives are $\frac{5}{8}$ inch deep and $\frac{1}{2}$ inch apart. The notched pieces may be made of galvanized iron 0.0508 inch thick,[1] cold rolled steel $\frac{1}{16}$ inch thick, or monel metal 0.0907 inch thick.

LAVATORY.

(Fig. 3.)

A lavatory with hot and cold water mixer, controlled by knee or pedal valve, should be installed near the transfer window, so that when a breaker finds a bad egg and has taken the soiled utensils to the window, she can wash her hands before obtaining clean equipment. The knee or pedal valve attachment obviates the necessity of touching faucets with soiled hands. A rack for paper towels should be located near the lavatory. The relative position of transfer window, lavatory, can door, and rack for towels is shown in figure 3. The lavatory with knee or pedal attachment may be purchased from firms selling plumbing supplies.

HOLDERS FOR TOILET PAPER.

Toilet paper is used for drying fingers during breaking. The rectangular boxes ordinarily used for holding packets of sheet toilet paper may be clamped to the standard supporting the tray rest of the breaking table. This arrangement is very satisfactory, as it brings the paper within easy reach of the breaker and keeps it from becoming soiled.

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[1] Equivalent to No. 16 Brown & Sharpe gauge.

FIG. 1.—WELL-LIGHTED UP-TO-DATE EGG-BREAKING ROOM.

FIG. 2.—WELL-LIGHTED UP-TO-DATE STERILIZING ROOM

FIG. 1.—FREEZER FOR CANNED EGGS.

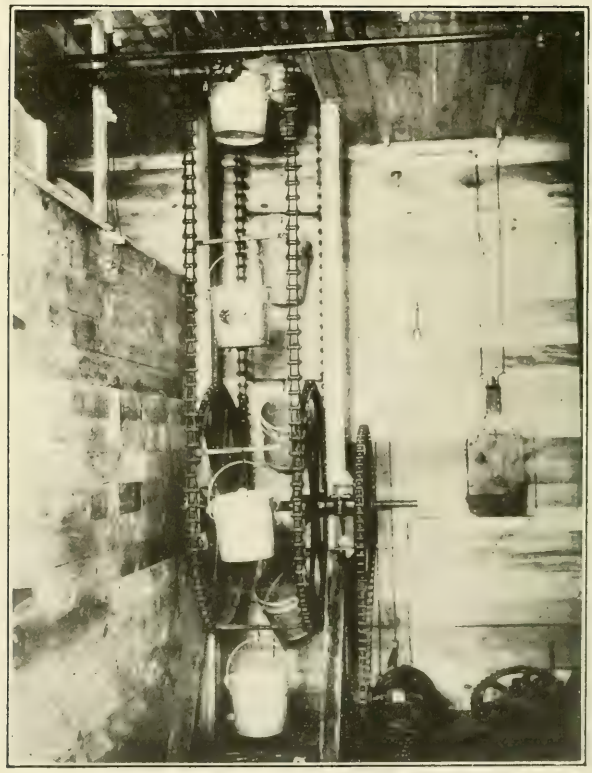

FIG. 2.—CHAIN CONVEYOR FOR SHELL EGGS.

CHURNS.

The churn in which the yolks are broken and mixed with the whites preparatory to freezing is one of the most important pieces of apparatus in the breaking room. Much money has been spent in building different kinds of churns, and the results often have been unsatisfactory. At present two types of churns are in use: One chills the eggs to nearly freezing during the churning process, and the other simply mixes the egg. In plants with ample refrigeration for chilling the eggs before they are broken and for freezing the liquid egg promptly it is not necessary that the eggs be cooled during churning. If these facilities are not at hand, however, it is most important that the liquid egg be cooled thoroughly before leaving the breaking room. Holding the egg in a warm condition, even for a few hours, results in rapid multiplication of bacteria.

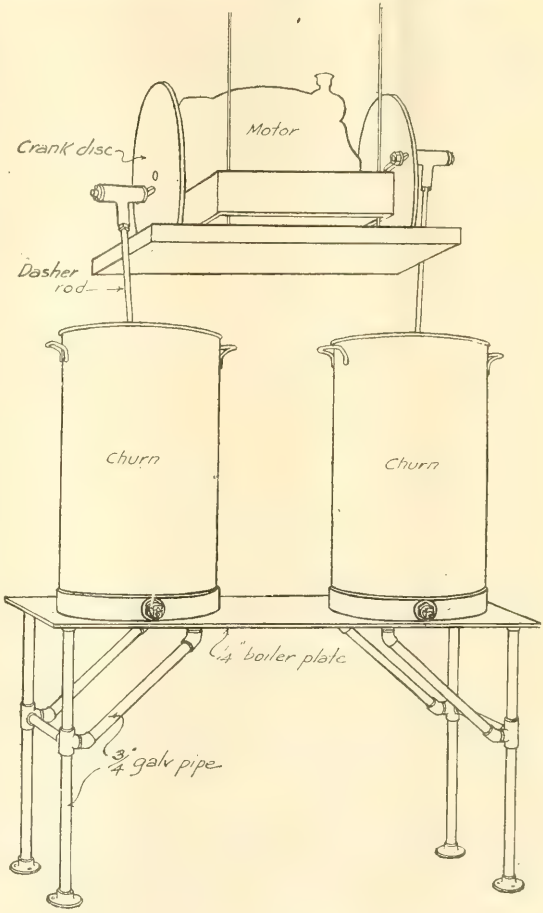

FIG. 18.—Churns in position for operation.

Refrigerated churn.—The type of refrigerated churn (Plate 1) which is being used more and more widely is a modified pasteurizing machine that may be purchased from dairy supply houses. This machine has a rectangular insulated tank in which is suspended a motor-driven paddle consisting of a coil through which brine is circulated to chill the liquid egg. The yolks of the egg must be broken before being put into the tank. This may conveniently be done by passing them through a motor-driven, sanitary pump attachment, which may be purchased from firms selling dairy supplies. This

machine has a sanitary faucet, through which the egg is drawn into the cans. It is simple in construction and easily cleaned. A small opening in the top allows the insertion of a hose for steaming. In other refrigerated churns an upright cylindrical tank is surrounded by brine coils inclosed by an insulated wall. A spiral dasher driven by a motor rotates in the machine and churns the eggs. The eggs usually are passed through a sieve into the machine. This churn must be made to order.

Churns without refrigeration.—This churn (figs. 18, 19, and 20) consists of a metal barrel and a dasher. The dasher is connected with the motor to a point off center of a crank disc, so that the same rotary motion is obtained as when the eggs are churned by hand. The churn is governed by automatic stops, which insures churning of each lot of eggs for a uniform length of time. Two churns commonly are operated by the same motor, a convenient arrangement, for one may be used for whole eggs and the other for yolks if desired.

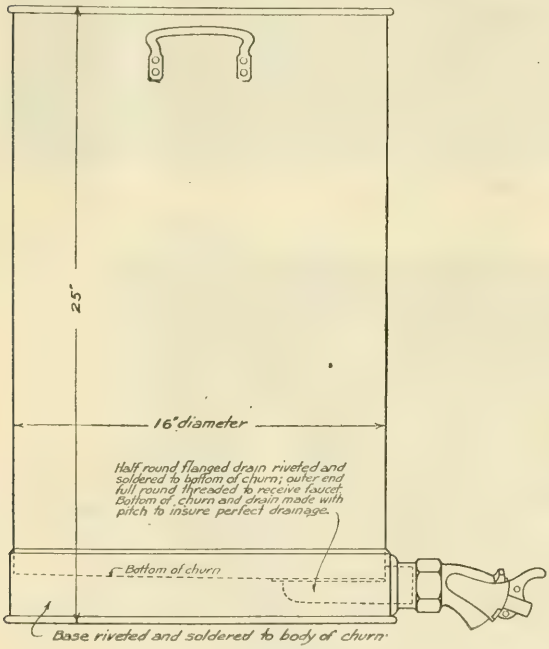

FIG. 19.—Churn barrel.

The barrels are made of monel metal 0.0320 inch thick,[1] or tinned or nickeled copper 0.0322 inch thick.[2] They are 14 inches in diameter and 23 inches high, with an additional rim or base 2 inches high at the bottom. The flange for draining is riveted and soldered to the bottom of the barrel, which is made with a pitch to the outlet, and extends through the base to receive a sliding gate porcelain-lined valve. This arrangement permits the draining of the contents of the barrel without tilting. The dasher (fig. 20) is made of monel metal or copper 0.1285 inch thick,[3] covered with nickel or tin, and is 1 inch less in diameter than the diameter of the barrel. The dasher may be equipped with one or two blades as desired. This machine

[1] Equivalent to No. 20 Brown & Sharpe gauge.
[2] Equivalent to 24 ounces per square foot.
[3] Equivalent to No. 8 Brown & Sharpe gauge.

has great advantage over the other churns described, because the parts are so light that they readily may be taken to the sterilizing room for washing and steaming.

A milk stirrer or a wire potato masher with the wooden handle removed and a wire handle soldered to the stem may be used for churning by hand small quantities of liquid egg in a can.

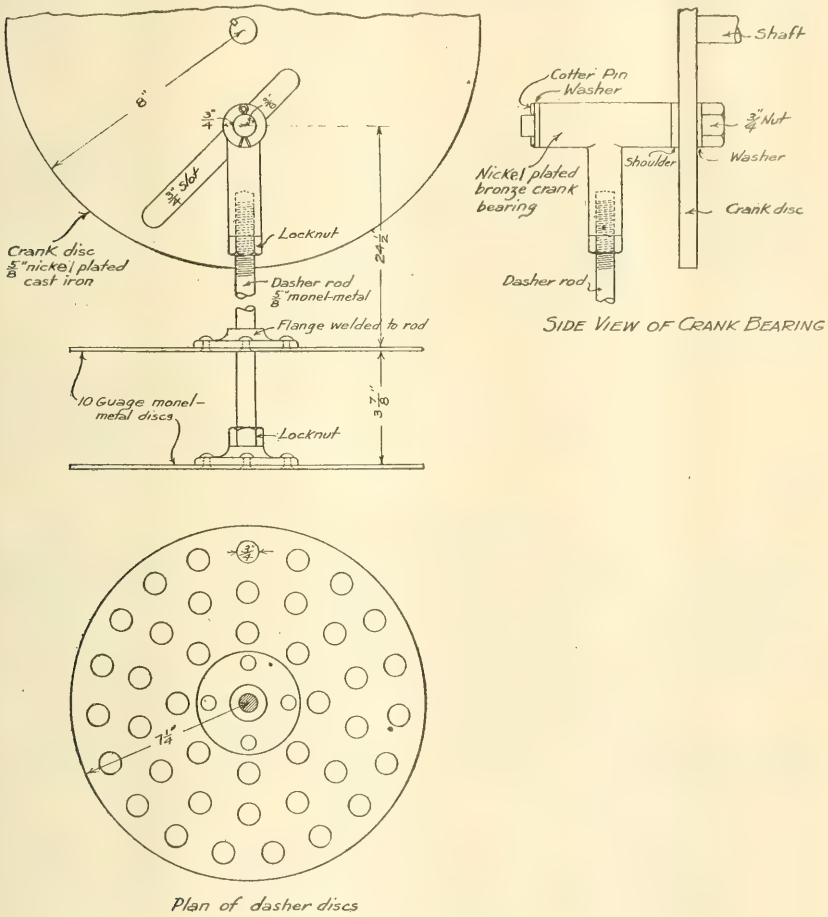

FIG. 20.—Detail of dasher.

SCALES.

Scales with a capacity of 100 pounds by 1 to 2 ounces are suitable for weighing cans of liquid egg. Platform scales with a double beam, or trip scales with a side beam, ordinarily are employed.

UNIFORMS.

(Pl. I.)

Three sets of uniforms should be provided for each worker in the breaking room. The aprons and caps for the women may be made

of heavy muslin or ducking from patterns purchased at dry goods stores. The aprons should be made with long sleeves, and cover the entire clothing of the worker. The operator in the sterilizing room should have a waterproof apron covering the white uniform. The men working in the breaking room should wear white caps, coats, and overalls made of ducking or other suitable material. These may be purchased from firms selling creamery supplies, and in some cases from dry goods stores.

CANS FOR FROZEN EGG.

(Pl. II, fig. 1.)

It is customary to sell frozen egg in cans with a capacity of 30 pounds. Sometimes smaller cans with a capacity of 20, 10, or 5 pounds are used, particularly for whites. The cans are usually made of 90-pound tin, and have slip covers. They may be obtained from practically any manufacturer of cans. The dimensions of the cans are as follows:

	30-pound can.	20-pound can.	10-pound can.	5-pound can.
	Inches.	*Inches.*	*Inches.*	*Inches.*
Diameter	$9\frac{5}{8}$	$9\frac{3}{4}$	$7\frac{1}{2}$	$5\frac{7}{8}$
Height	$12\frac{5}{8}$	8	$7\frac{1}{4}$	$6\frac{3}{8}$

STERILIZING ROOM EQUIPMENT.

The proper equipping of the sterilizing room is very important in the preparation of a clean product. The equipment should include sinks with draining racks, mechanical rinsers, and steam sterilizers. The arrangement of apparatus shown in figure 1 has been found very convenient for cleaning a large number of utensils in a short space of time. The sinks are placed next to the windows where they receive the best light. The trays of soiled utensils from the bottom shelf of the transfer window are placed on the nearest draining rack, washed and rinsed in the adjoining sink, collected on the draining rack to the right, sterilized, then returned to the upper shelves of the window. The other sink is used for cleaning larger utensils, particularly cans. The sterilizers ordinarily are placed against the wall opposite the sinks.

WASHING FACILITIES.

Sinks.—The sinks (fig. 21) should be connected with trapped ventilated drains, and should be supplied with hot and cold water. The sink ordinarily used has a round bottom with a steel body, wrought iron legs and supports, and angle iron around the top. It is entirely galvanized. It is 2 feet wide, 16 inches deep, 33 inches high, and may be purchased in lengths varying from 3 to 6 feet. Two sinks, 3 feet long, separated by a draining rack (fig. 1), are more con-

venient than one large sink. In small plants one sink 3 or 4 feet long, equipped with draining racks and a rinser, will be sufficient. The legs of the sink should be spliced or set upon blocks, so that the top of the sink is 36 inches from the floor, because the sinks usually sold are too low for comfortable work.

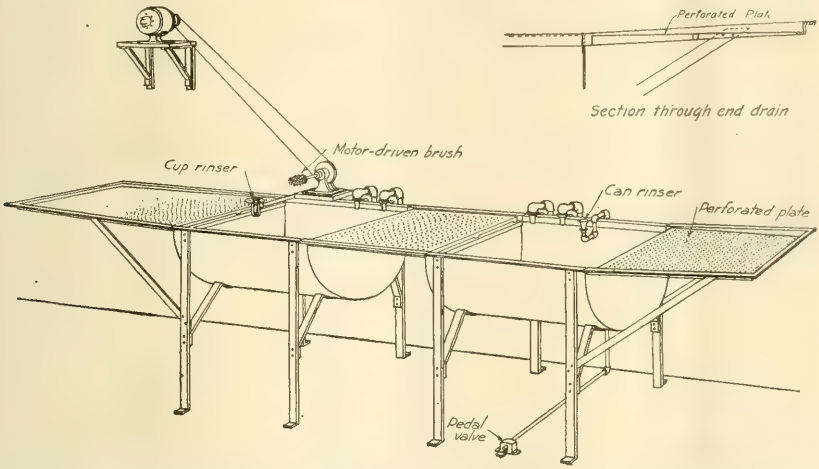

FIG. 21.—Sinks in sterilizing room, showing arrangement of cup rinser, motor-driven brush, drains, and can rinser with pedal valve attachment.

Draining rack.—The draining racks (fig. 21) are made by riveting and bracing a 1½-inch angle iron frame to the ends of the sinks and covering neatly with galvanized iron 0.0201 inch thick. The outer drains are made with a slight pitch, so that the water from the wet utensils will run back into the sink. The length of the drains depends

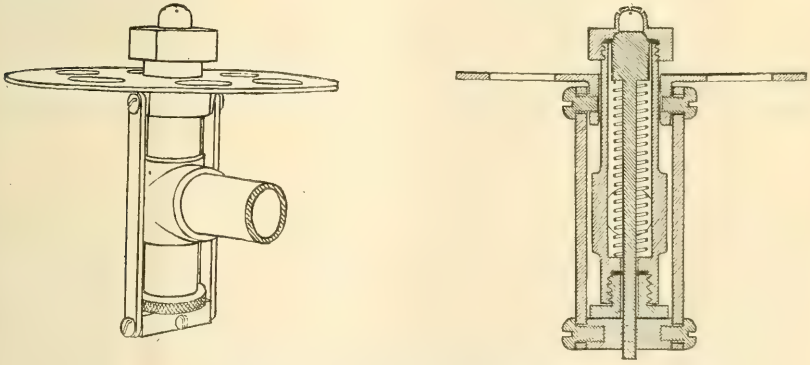

FIG. 22.—Cup rinser (perspective and cross section.)

upon the size of the sterilizing room. It is convenient to have the draining rack for the sink next to the transfer window 5 feet long, and the others 2 feet long. On each drain rests a galvanized iron plate 0.0201 inch thick, with perforations ¼ inch in diameter and with centers 1 inch apart. It is supported above the drain in a

level position by means of legs soldered to the drain itself or by means of solder or metal posts in the corners of the draining rack. This perforated plate permits the drippings from the utensils to drain in the sink.

Rinsers.—It is important that after washing the utensils they be rinsed in clean water before sterilization. This can best be accomplished by mechanical rinsers (figs. 21, 22, and 23).

Rinsers of the percussion valve type, obtainable from plumbing supply firms, may be used for rinsing cups (fig. 22). A nozzle threaded to attach to a water pipe and operated by a pedal valve located on the floor may be used for rinsing large utensils (fig. 23). Bottle rinsers, which may be purchased from bottle machinery firms, are also used, and are much less expensive than the percussion valve type. By the attachment of a perforated metal plate about 1 foot in diameter, this rinser may be used for both cups and larger utensils. Each sink should be equipped with a rinser.

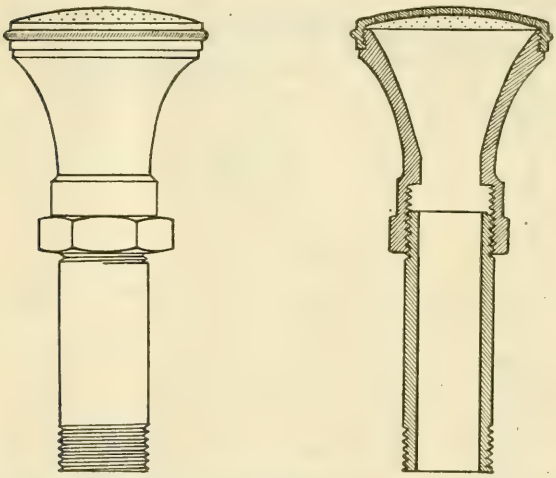

FIG. 23.—Nozzle for rinsing pails and cans (in perspective and cross section).

In plants with eight breakers or more, it is economical to install a mechanically rotating brush for washing cups. Bottle-washing machines, driven by a quarter horsepower motor, may be purchased for this purpose from dairy-supply firms.

STEAM STERILIZER.

(Fig. 24.)

The steam sterilizer is an essential part of the equipment of a sterilizing room. Bottle sterilizers suitable for the purpose may be purchased from firms selling dairy supplies. It is more economical of steam and time for plants with more than eight breakers to have two small sterilizers rather than one large one, because one may be operated while the other is being filled and less steam is used when small lots of equipment are sterilized. In smaller plants one sterilizer will be sufficient. In plants where one or two girls are breaking, or in houses where only leaking eggs are opened, a small sterilizer used on a gas stove (fig. 25) may be substituted. This sterilizer, which

is inexpensive and which may be made by any tinner, is described in detail by Ayers and Taylor.[1]

Specifications.—Sterilizers usually are made of galvanized iron or steel well braced. They are made approximately 3 feet high, from 2½ to 3 feet deep, and 4 to 5 feet wide. The doors should have self-tightening locks, and be fitted with rubber gasket or cork. The steam is distributed through the sterilizer by means of a perforated

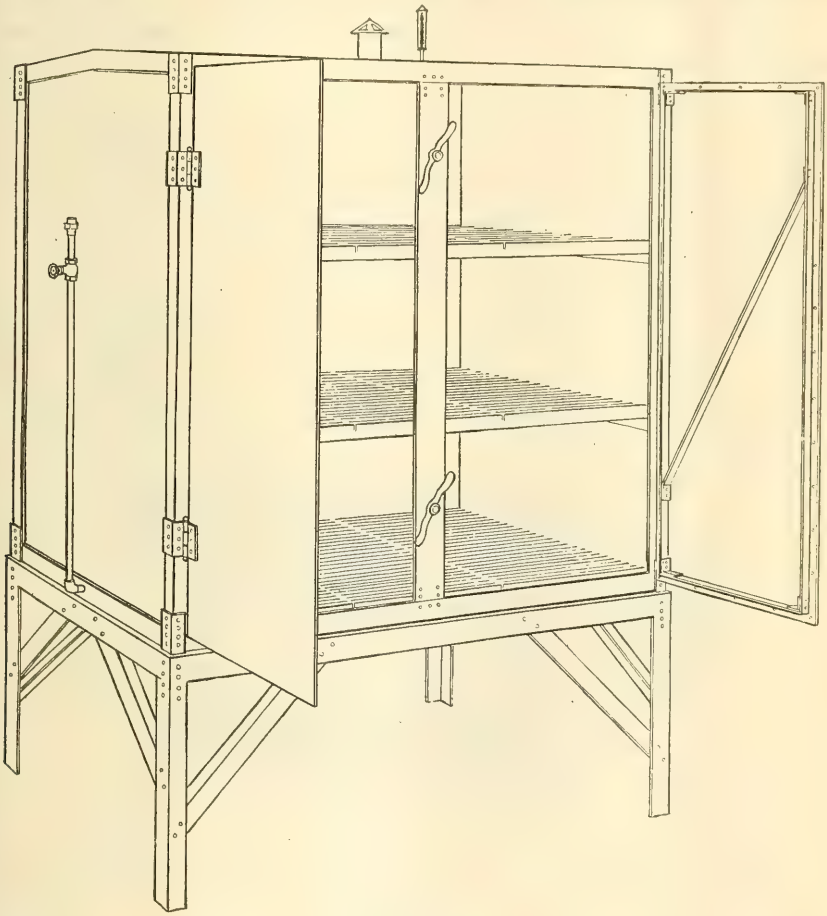

FIG. 24.—Steam sterilizer.

pipe placed near the bottom. The floor of the sterilizers should be pitched toward the center, and should be connected to a drain protected by a steam trap, and, when practicable, there should be a flue provided with a valve or damper. Each sterilizer should be equipped with a thermometer and have removable shelves. The sterilizers should rest on bases about 2 feet high, made of pipe or

[1] U. S. Dept. Agr., Farmers' Bul. 748, "A Simple Steam Sterilizer for Farm Dairy Utensils."

angle iron. The pressure of steam should be sufficient to maintain temperatures of 210° to 212° F. If there is not an available supply of steam, a boiler heated with coal or gas should be installed (Plate I). Gas boilers have been found very convenient for this purpose.

CONCLUSIONS.

An egg-breaking plant should have an insulated refrigerated chillroom, candling room, freezer, and breaking room. Adjoining the breaking room should be a room for the washing and sterilizing of utensils.

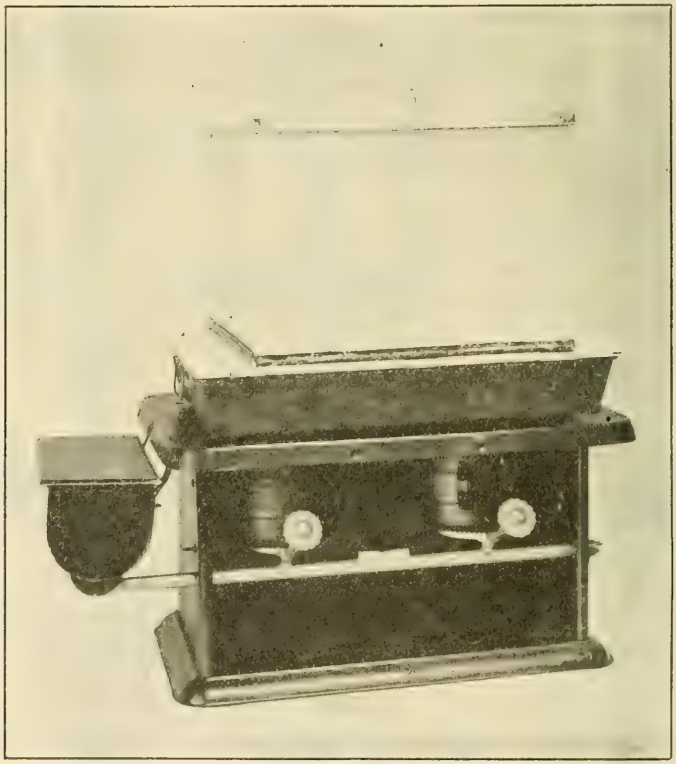

FIG. 25.—Small steam sterilizer used on gas stove. (Reprint from Farmers' Bulletin 748.)

The breaking and sterilizing rooms should have a plentiful supply of natural light. The walls and ceilings should be plastered and white enameled, and the floors should be concrete with trapped drains. In the partition between the two rooms a sliding window for the transfer of equipment should be built.

The freezer should be equipped with shelves of brine piping, through which brine is circulated for freezing the cans of liquid egg.

The candled eggs should be taken to the breaking room in metal

pails, because cases with the accompanying packing material are dirty. Leaking eggs after candling should be placed on special trays for transferring to the breaking room.

The egg-breaking outfit consists of a tray, on which is placed an open rack for supporting the cups, and a detachable knife on which the eggs are broken. This knife rests in slots in standards fastened to the ends of the breaking tray. Glass cups should be used for the grading of the opened eggs, because certain types of bad eggs can not be detected in nontransparent containers. When whites and yolks are separated it should be done by means of a sanitary mechanical device.

The egg-breaking tables should be covered with a nonabsorbing material, such as metal or porcelain.

A churn for mixing the egg before freezing should be provided. It should be constructed so that it can be readily washed and sterilized.

A lavatory with knee or pedal valve attachment should be installed in the breaking room near the transfer window for the washing of hands after breaking bad eggs.

White uniforms should be provided for operators in the breaking room.

The sterilizing room should be furnished with sinks and steam sterilizers. The sinks should be equipped with drains and mechanical rinsers and should be supplied with hot and cold water and connected to trapped drains.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO FROZEN AND DESICCATED EGGS.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

A Bacteriological and Chemical Study of Commercial Eggs in the Producing Section of the Central West. (Department Bulletin 51.)

A Study of the Preparation of Frozen and Dried Eggs in the Producing Section. (Department Bulletin 224.)

How to Candle Eggs. (Department Bulletin 565.)

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A Bacteriological Study of Shell, Frozen, and Desiccated Eggs, Made under Laboratory Conditions. (Bureau of Chemistry Bulletin 158.) 1912. Price, 10 cents.

Practical Suggestions for the Preparation of Frozen and Dried Eggs. (Bureau of Chemistry Circular 98.) 1912. Price, 5 cents.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 664

Contribution from the Bureau of Chemistry
CARL L. ALSBERG, Chief

Washington, D. C. ▼ April 25, 1918

THE PREVENTION OF BREAKAGE OF EGGS IN TRANSIT WHEN SHIPPED IN CARLOTS.

By M. E. Pennington, *Chief, Food Research Laboratory*, H. A. McAleer, *Investigator in Poultry and Egg Handling*, and A. D. Greenlee, *Assistant Chemist*, assisted by F. X. Dailey and H. C. Albin.

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REASON FOR THE INVESTIGATION.

Breaking the shell of an egg shortens its market life in direct proportion to the extent of the damage. A complete mashing of the shell immediately renders the egg useless for food purposes; a crack visible to the naked eye foreshadows prompt decay, and necessitates immediate consumption; while even the slightest fracture of the shell makes impossible satisfactory preservation for use when eggs are scarce. The shell of the egg is fragile; yet it must frequently travel far by varied conveyances, and successfully withstand comparatively rough usage, if it is to satisfy marketing requirements.

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The need for the elimination of waste and loss in the transfer of food from the producer to the consumer suggests that the breakage of eggs in transit carries with it a loss of both money and food which it is highly desirable to prevent. The investigation reported in this bulletin was undertaken to determine the causes of such damage. Suggestions for lessening the extent of the damage are also included. The investigation was made with the hearty cooperation of the shippers and receivers of eggs, as well as of the carriers. To obtain the maximum of ease and efficiency, the joint conference committee[1] acted for both shippers and carriers, and handled all matters requiring concerted action on the part of the cooperators. Without such an organization this investigation could not have been made, and this opportunity is taken to express to the committee, to the industry, and to the carriers an appreciation of the assistance rendered.

AMOUNT OF DAMAGE TO EGGS DURING MARKETING.

The amount of damage sustained in the marketing of eggs can not be stated with exactness. Estimates by those familiar with conditions, and experiments conducted to determine the rate of deterioration in eggs during their journey to the consumer, however, have given figures which are worthy of consideration. In 1909, Hastings[2] stated that the usual western produce dealer, whose supplies come by local freight, receives from 4 to 7 per cent of cracked eggs, and that 8 per cent of broken eggs from the hen to the market is probably a fair estimate. In 1913, Lamon and Opperman[3] studied egg deterioration between the farm and the egg-packing house, and shipped eggs under conditions distinctly better than the average. They reported 2.7 per cent cracked eggs, and so few leakers that the percentage is not given. A study made in the Food Research Laboratory, of the Bureau of Chemistry, instituted for another purpose, which will be reported in detail in another publication, showed that about 6.19 per cent of cracked eggs were received by one shipper in a western State during the months of April to August, inclusive, when the total volume of eggs handled amounted to over 1,357,000 dozen. In 1910, Pennington and Pierce[4] reported that the examination of over a quarter of a million dozen eggs, received in the city of New York, showed 8.98 per cent cracked.

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[1] The joint conference committee consists of representatives from the National Poultry, Butter, and Egg Association, for the industry, and from the General Managers Association of Chicago, for the railroads in cooperation with a representative of the United States Department of Agriculture. Its object is, primarily, to improve the quality of poultry, butter, and eggs on the market, and prevent waste and loss.

[2] U. S. Dept. Agr., Bureau of Animal Industry Circ. 140.

[3] U. S. Dept. Agr., Bureau of Animal Industry Bul. 160.

[4] The Effect of the Present Method of Handling Eggs on the Industry and the Product. U. S. Dept. Agr. Yearbook (1910) Separate 552.

Mashed eggs were not recorded in any of these observations. In commercial practice such eggs are reckoned with the total loss, which includes also rotten eggs. Most of the cracked eggs found a market in the city, but their keeping quality was so impaired that consumption had to be immediate, and they were sold at a lowered price. In many instances, also, the cracked and leaking eggs provoked so much bickering between shipper, carrier, and receiver that the egg trade itself suffered. Quite aside from this phase of the situation, however, the actual damage to a valuable food product, as indicated by the foregoing figures, would abundantly warrant any reasonable reforms by which the amount might be lessened.

PROGRESS OF THE INVESTIGATION.

GENERAL PLAN.

The work here reported was begun in Texas, in March, in the early part of the carlot shipping season, and gradually progressed toward the north until September, when the investigators had reached Minnesota. The lack of eggs made it difficult to get carlots after the middle of September. Shipments went to eastern markets, ranging from Pittsburgh and Buffalo on the west, to Boston on the north, and to Philadelphia on the south.

The investigation was carried on for two seasons in 32 packing houses, 5 of which were under observation both years. The shipments were observed in 39 eastern terminals in 20 large and medium-sized cities. In 5 cities shipments were received during both years. The total number of consignees was 33. All of the shipments were made in refrigerator cars, 23 refrigerator car lines being represented. The various routings, combined, covered most of the great trunk lines passing from West to East, and involved 32 railroads. The average haul was 1,200 miles. Records at origin and destination of 147 shipments were kept. In addition to this, many examinations were made at the terminals of carlots, on which less definite information was obtainable, but from which, nevertheless, much that was instructive could be learned. Occasionally investigators accompanied freight trains on which experimental shipments were being carried to observe the effect of fast or ordinary running, switching, coupling, and other conditions in transit.

CONDITIONS AT POINT OF ORIGIN.

THE EGGS AND THE PACKAGE.

In order to determine the soundness of the eggs which left the point of origin the investigators examined from 3 to 10 cases, taken at random from the stack of cased eggs which had been candled or clicked and were ready for shipment. The number and character

of the eggs with damaged shells were found by candling or clicking. Each egg was again placed in a new symmetrically made standard case, of gum, tupelo, or cottonwood, with new medium flats and fillers, evenly cushioned on the bottom with excelsior, and on the top with excelsior or with corrugated board laid over the top flat. The cushions were thick enough to fill the space between the eggs and lid, and were so evenly distributed that the lid exerted an even pressure over the whole top of the case. Five 3-penny, cement-coated nails to each joint were used in the experimental cases shipped.

The character of the shell of each egg, the size of the egg, and its location in the case were charted on a diagram by means of which permanent records were kept of the condition of every egg under observation. The cracked eggs were not removed from the case to be shipped, but the location of each cracked egg was recorded. The cases were marked so that they might be identified only by the investigators during the stowing or subsequent unloading of the car. A total of 5,490 dozen eggs examined in 12 packing houses during the first season showed that 19.22 eggs per case, or 5.34 per cent, were being shipped with shells lightly cracked or dented.[1] Leakers were seldom found, and when found were removed. During the later work in 27 packing houses, when a total of 16,800 dozen eggs were examined, 5.47 per cent of eggs with unsound shells were found.

This damage in cases of eggs as they leave the packing house is not the damage which is visible in the usual terminal inspection, as will be brought out more fully in the course of this report. It is detected when eggs are shipped to storage warehouses for long holding, and the condition of the cases is such that even those which do not show external damage must be rehandled and candled or clicked for cracks. Experiments on the shipments of checks, to be given later (Table 4), will further elucidate this subject. The number of eggs with cracked and dented, but not leaking, shells observed during the investigation in the cases leaving the various packing houses is given in detail in Table 3.

TRANSFER OF EGGS FROM PACKING HOUSE TO CAR.

The experiments on which this report is based included the carrying of the cases by hand from the stack or chill room to the car, as well as their transfer from like locations by means of 2-wheeled trucks, or, very rarely, 4-wheeled trucks. In one case, an autotruck carried the cases about 500 feet to the car. Usually wagons were used. The distance between the packing house and the car varied from the width of the loading platform to nearly a mile.

[1] An experimental error of 1 to 2 eggs per case (0.28 to 0.56 per cent) should be allowed on all cases. It has not been found possible to rehandle 360 eggs without an occasional error.

STOWING THE LOAD.

During the earlier part of the investigation, no suggestions were made regarding the manner of loading the cars, but records were kept in detail of the routine in each house, and the effect of the various practices on the safety of the eggs. The effect of such practices as walking on cases, which materially increased top-layer breakage, and of rough handling given the cases as they were placed in the car, was evident at destination. The buffing of the cars, if any was used, and the manner of bracing were factors that showed even more plainly. The results obtained later in the work led the investigators to stow the load according to definite methods, and to make it as rigid as possible.

PLACING CASES IN CAR.

Two methods are commonly used in placing cases in the car, namely, the "straight-joint" and "step" or "broken-joint" loads.

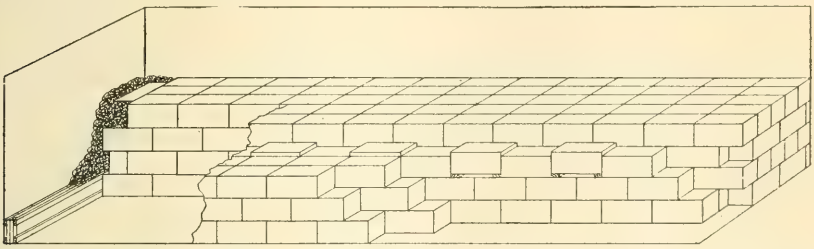

FIG. 1.—Car loaded from side. Frame to enable cold air from bunkers to enter the car. Note crosswise cases at end of the load in alternating layers, to give "step" effect.

In the first, a row of cases is set across the end of the car at the bunker, and others are placed on top until the desired height is reached; a second row is placed in front of the first, built up to the desired height; and so on to the center of the car. The other end of the car is then stowed, and any extra space which remains in the middle of the car is filled with wooden braces or some other form of buffing. The second method, by which the cases are placed like bricks in a wall (fig. 1), almost invariably entails walking on the cases, which is likely to cause breakage in top layers. It also necessitates placing a few cases crosswise at the bunker.

Primarily to avoid walking on the cases when making a step load, and incidentally providing many advantageous features, a few shippers have adopted what is termed the "side-load" method of placing cases (fig. 1, and Pl. I). This consists in placing a row[1] the entire length of the car against the far side, leaving the excess space at one or both bunker ends, as desired. A sufficient number of layers to

[1] "Rows" designate cases placed parallel to the side of the car. "Stacks" indicate the cases across the width of the car. "Layers" express the vertical stacking of cases.

give a load of the necessary height is placed on the first row. Then a second row is begun, and the layers added just as in the case of the first row. The building of rows is continued until the car is filled. The last row on the open-door side is built from both ends until a space for a stack of single cases only remains in front of the door. Any excess space in the width of the car is left on the loading side. If it is more than 2 inches, a "2 by 4"[1] of proper length should be wedged between ceiling and floor halfway between the door and the bunker in each end of the car, to guard against side shifting. The upright should not be nailed, merely wedged tightly. The buffing and bracing of such a load is described on pages 6 to 7.

All these methods of placing cases were studied at the shipping point, and diagrams were made of the load as it appeared when finished, that accurate information might be available at the terminal.

BUFFING THE LOAD WITH STRAW.

During the early part of this work no attempt was made to alter the routine buffing used by different shippers. The results of the various ways of applying straw or wood was noted when the cars reached destination. The study was begun about the time a general interest was awakened in straw buffing for bunker ends of cars, and to fill spaces when they occurred between the cases at the middle of the load. It was observed that there were almost as many ways of using straw as there were shippers sending cars so buffed. In many instances the straw was so loosely placed that it offered no resistance to the shifting load, which often showed twisting or even a complete overturning of the cases in transit.

Loading cars from end to center, when placing cases with either straight joints or step joints, makes the ramming of the straw between the load and the bunkers a difficult matter, even when the cases are freely walked over during the work. On the other hand, the method of loading from the side permits the operator to stand on the floor while placing the straw between the cases and the bunker. It is possible in the side-loading method to pack tightly, since the operator has the entire row of cases to push against as well as a freedom of action not possible when he works over the tops of the cases, which is the more common practice (Pl. II).

The cost of straw for buffing is ordinarily from $2 to $3 per car. Occasionally the price is so high as to be prohibitive. From 2 to 3 bales of straw per car are required.

Refrigeration in straw-buffed cars.—It has been observed that many shippers who use straw for buffing against the bunker close the lower opening through which the cold air enters the car. The

[1] The term applied to lumber cut 2 by 4 inches.

straw, if packed tightly enough to prevent the shifting of the load, greatly decreases refrigeration. In order to secure the benefit of the cold air from the bunkers (p. 25) and at the same time use straw as a buffing, a small frame was made from scantling, as shown in figure 2. It fitted closely across the car, was the height of an egg case, and just wide enough to go into the space not filled by the egg cases. The lids of cases were laid on the frame to keep the straw from falling through, and on them the buffing was placed in the usual manner. As an additional means of securing efficient refrigeration, one row of cases was omitted from the first layer, and the extra space divided into runways the entire length of the car. In this way it was possible for the cold air to circulate from bunker to bunker. The solid load above held the lower layer in place.

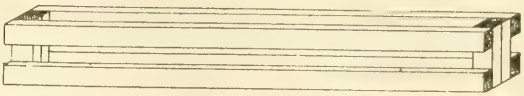

FIG. 2.—Frame placed in front of ice bunker to keep the straw buffing from blocking the cold-air exit in straw-buffed cars.

BUFFING THE LOAD WITH WOODEN FRAMES.

It has long been the custom of many shippers to fill the excess space in egg cars with some sort of wooden framework,[1] known as "braces," "racks," or "frames" (fig. 3). Grain doors, where available, are also employed for this purpose. The underlying requirement for the successful use of any of these devices is that the space shall be completely filled and the load in both ends of the car tight.

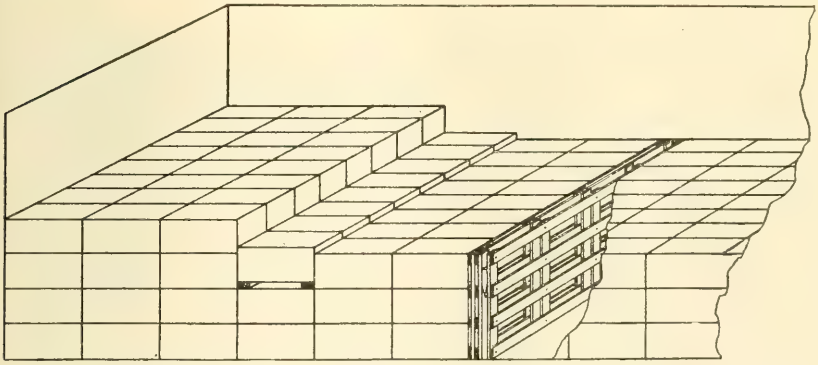

FIG. 3.—A modern frame used as buffing to fill a large space in doorway of car. Built of 2 by 4's made in 2 sections with struts between.

In a comparatively small number of cases ready-made frames of some sort are obtainable. Even so, the supply is not always ade-

[1] For the purposes of this report, the filling of excess space in the car to prevent shifting of the load during railway travel will be called "buffing," regardless of the kind of material used.

quate, for in the heavy shipping season a large number are required. At a much greater number of places ready-made frames have never been seen. Then the making of some such device devolves upon the shipper. He will find that 2- by 4-inch lumber is commonly the most satisfactory material. The frame must be very rigidly constructed, and must fit the space in the car that is to be filled. After the frames are placed in position, a wedge may be driven down between them to make them tight. The lumber needed to make such a frame costs from 30 cents to $2, depending upon the size of the space to be filled.

BRACING THE LOAD.[1]

Bracing is not needed when the number of cases in the load or the size of the car is such that the top layer of cases completely fills the car from bunker to bunker. Very commonly, however, there is a shortage of cases on the top layer, so that it does not extend from end to end or to the middle buffer.

The preliminary survey of the industrial practices showed that many loads were self braced—that is, the weight and position of packages were depended upon to keep them from shifting or roaming free over the interior of the car. Another practice is to nail beams over or in front of cases to be braced, the lumber being usually a 2- by 4-inch strip. These beams are nailed to the walls of the car, either directly or by way of blocks. Obviously, these nails ruin the insulation of the refrigerator car and almost always fail to hold the brace. The 2 by 4 is commonly placed with the 4-inch side vertical, making the strain come against the weakest dimension and causing it to snap. The time and expense in procuring, adjusting, and fastening these braces is practically wasted (p. 26).

This unsatisfactory condition led to a search for an efficient, cheap, and simple brace. In response to the need, a brace consisting of two 2 by 4's (fig. 4), so placed across the width of the car that the

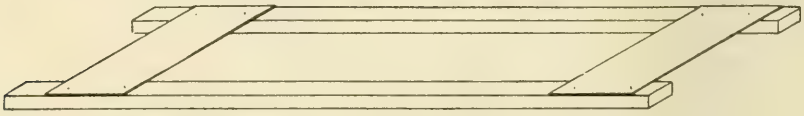

FIG. 4.—Brace of 2 by 4's to be used under cases and placed across the car to prevent shifting to top layer.

row of cases immediately in front of the incomplete top layer is raised about 2 inches (fig. 3), has been developed. If the strips are laid on the floor, the placing of the load must be accurately planned to make sure that they are in the proper position. If the

[1] For the purposes of this report, the term "bracing" will express the means by which a lesser number of cases than a full layer are prevented from roaming during transit.

FIG. 1.—STRAIGHT-JOINT LOAD, PLACED FROM THE SIDE.

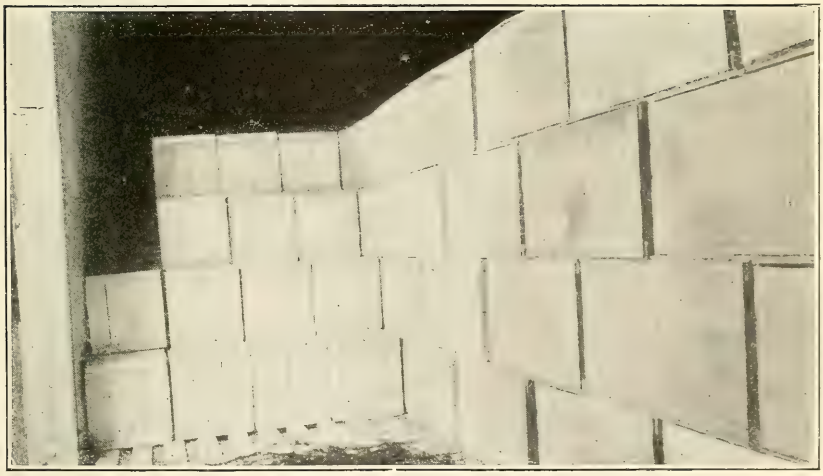

FIG. 2.—STEP-JOINT LOAD, PLACED FROM THE SIDE.

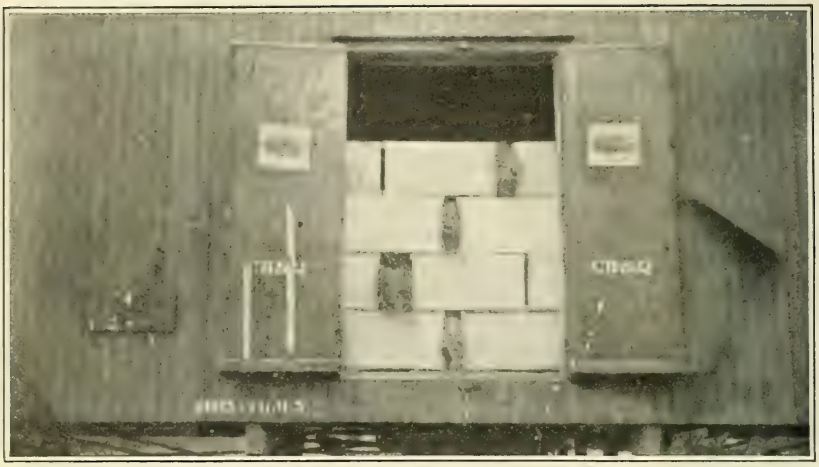

FIG. 1.—STEP LOAD, PLACED FROM ENDS, CENTER SPACES FILLED WITH STRAW. WORK UNUSUALLY WELL DONE.

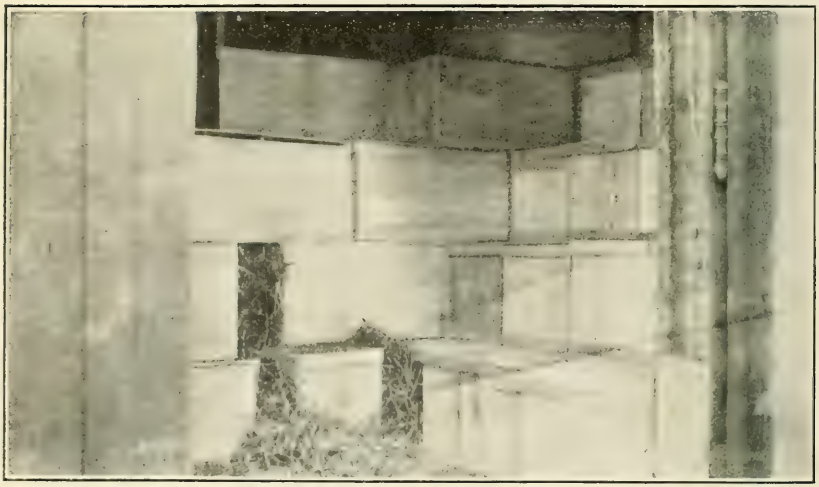

FIG. 2.—STEP LOAD, PLACED FROM ENDS. CONFUSION AT THE CENTER, AND SPACES LOOSELY FILLED WTH STRAW.

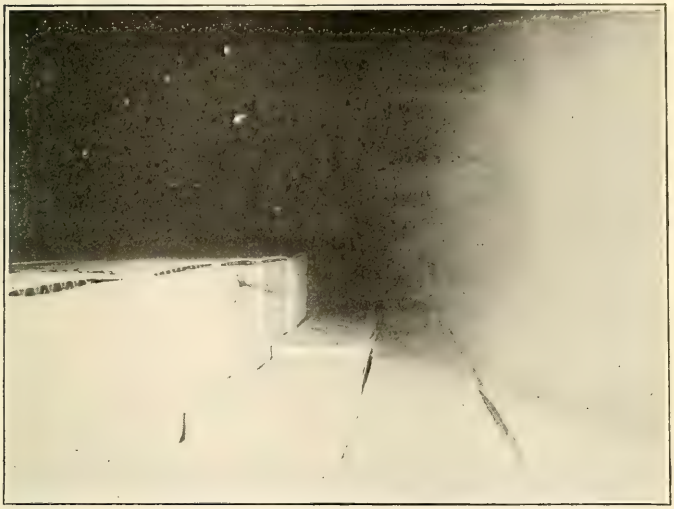

FIG. 1.—LATERAL BRACES UNDER ALTERNATE CASES, STEP-JOINT LOAD, PLACED FROM ENDS.

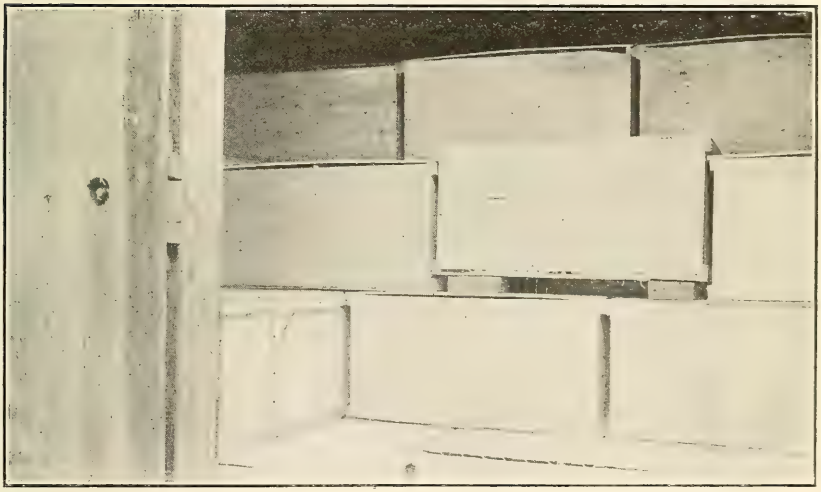

FIG. 2.—LATERAL BRACES UNDER ALTERNATE CASES, STEP-JOINT LOAD, PLACED FROM THE SIDE, SHOWING BRACES (VIEWED FROM DOOR.)

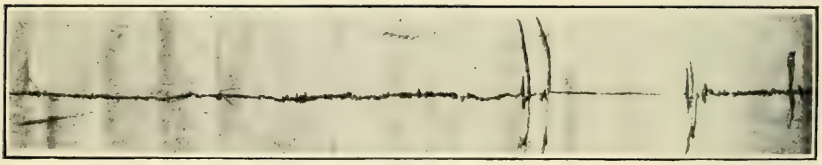

FIG. 1.—SLOW-RUNNING TRAIN.

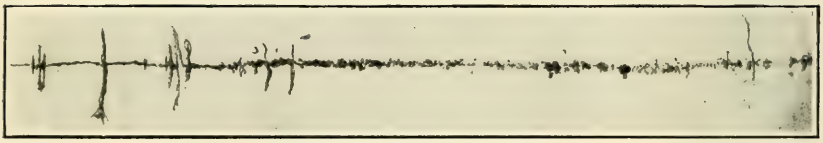

FIG. 2.—FAST-RUNNING TRAIN.

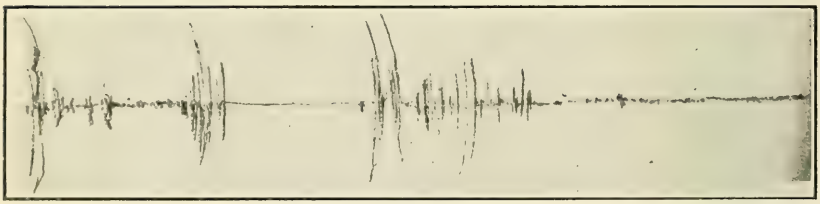

FIG. 3.—YARD SHIFTING.

SHOCKS TO EGGS IN TRANSIT, AS RECORDED BY THE IMPACTOGRAPH.

number of cases is indefinite, the strips may be laid under the desired row on the next to top layer, in which circumstance old case lids should be nailed from strip to strip, here and there, to insure their remaining parallel (fig. 5).

A strip the entire width of the car is available when the end form of stowing is used in placing a step-joint load, and also when the load is of the straight-joint type. If the step load, placed from the side, is to be braced, the same principle may be employed by cutting 2 by 4's into 11-inch lengths (fig. 5), fastening them together with old case lids, and putting one such brace under every other case on the row in front of that to be held in place (fig. 1). It will readily be seen that these lateral braces under the ends of the cases lend themselves to a great variety of puzzling situations. A few of the most usual ways in which they have been found useful are shown in figures 1, 3, and 6, and Plate III. These illustrations show cars stowed with straight- and broken-joint loads, in which the lateral braces under cases were used. If the method of side loading is used, the incomplete layer will extend the length, rather than the width, of the car. In this case the short braces, spaced by pieces of old case lids, as in the step-joint load (fig. 1 and Pl. III), are used.

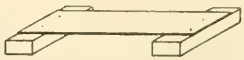

FIG. 5.—Small brace, to be used under individual cases in step-joint load to prevent shifting of top layer.

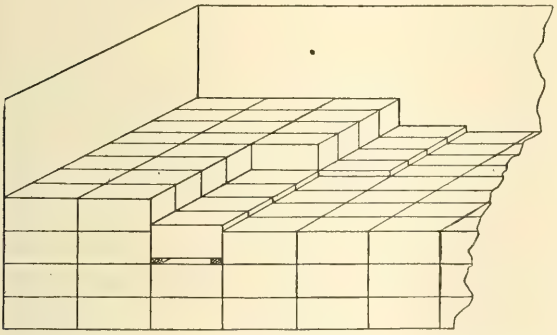

FIG. 6.—Lateral braces under cases in a straight-joint load. Layer 4, stack 3, contains only 4 cases. When such incomplete stacks are to be braced, the strips under the cases must be in at least 2 sections.

THE RAILROAD HAUL.

It has been difficult to devise a method of recording the shocks incident to ordinary freight-train running and handling as felt in the carload of eggs. Several instruments termed "impactographs" have been devised, and these have been used in the egg car itself, as well as in the caboose which the investigators occupied in accompanying the carload of eggs under observation from origin to destination. A number of records, having the same general character as those shown in

Plate IV, have been obtained, but it has not yet been possible to assign to the tracings any accurate value in pounds pressure or other standard expression of force. To observe the working of the impactographs the investigators rode in freight cars with the machines and watched the records they made, noting by actual observation the relation between the character of the record of train movement and the condition of the eggs in the cases. Plate IV indicates that the shocks incident to yard shifting are much greater than those due to lurching and air brakes while running, even when the speed of a train of 60 cars reaches 45 miles an hour.

A very large amount of damage is caused because the packages get wet, especially those on the floor of the car. A wet filler affords practically no protection to the eggs. A wet floor is generally caused by faulty bunkers or clogged drains, due to dirt from the ice, or failure to remove the slime from the bunker. Observations made during one season showed that 38 per cent of all the egg cars examined were more or less damaged by water. Much, if not all, of this damage can be prevented by washing the ice more carefully befor it is placed in the bunkers, especially where natural ice, which has been packed in sawdust, is used. Too often the so-called washing merely pushes the sawdust around to the lower side of the cake of ice, so that it eventually enters the bunker.

CONDITIONS AT THE TERMINAL.

The 39 terminals at which shipments were received and observations made included freight houses on Manhattan Island, station piers,[1] to which the cars had been transferred by ferry, private warehouses, and the railroad yards of Philadelphia, Boston, and other cities east of Buffalo and Pittsburgh. A freight train upon arrival at destination is broken up into groups or strings of cars, which are shunted and shifted by yard engines in classifying them for delivery to the receivers. The receiving freight yard is usually a large one, and is generally located at some distance from the actual unloading terminus. The cars may have to pass through minor yards before they reach their proper station. The delivery is made at one of four receiving locations, namely, a freight house, a freight yard, a station pier, or a private warehouse or siding. A brief description of each form of terminal follows, and the general method of handling is indicated.

Freight houses are usually located near the point of commercial activity. They serve the purpose of inbound and outbound freight. Some have separate tracks and platforms for each, but often the same

[1] Droege, John A. Freight Terminals and Trains. (1912.) McGraw Hill Book Co., London.

tracks are used for inbound and outbound traffic. A car delivered at the station is unloaded by employees of the railroad, in gangs of such number that they may work rapidly without interference in going in and out of the car. In nearly every instance, as soon as the doors are opened, the cars are examined by an inspector, who notes and reports the condition of the load. The method ordinarily pursued in unloading egg cases is to use a 2-wheeled truck with 3 or 4 cases to the truck load. Three cases to the load were seen more often than 4. The cases were trucked to a designated section of the house, where the consignment was placed in stacks, usually 5 cases high. At the freight houses of one prominent railroad all cases of eggs have been handled by hand for a number of years, each case being carried out from the car to the stack by a man. All freight gangs are managed by a general foreman and numerous subforemen.

In a freight yard, where freight is delivered, the car tracks are usually arranged in pairs with driveways between to allow delivery from either track direct to wagons or trucks. The handling in fregiht yards is usually done by employees of the consignee.

A station pier is a water-front terminal, and contains no railroad tracks. It is usually a long pier, 600 or more feet, extending out into the harbor, with doors along both sides to facilitate delivery from the cars, which are on a boat, barge, or float tied up to the pier. Cars intended for such a station are loaded on huge floats (Pl. V, fig. 1), formerly made of wood, but now usually all steel. The floats hold from 12 to 24 cars, with an equal number on either side. When the float is to receive cars it is fastened to a transfer slip, an adjustable bridge capable of being raised or lowered. This operation, which requires most careful handling, is accomplished without any noticeable jolt or jar, so that damage at this point is rare. The floats are conveyed by a tug from the slip to the pier, to the side of which they are fastened securely, to await unloading (Pl. V, fig. 2). The handling on the station pier is similar to that at freight houses. In a tide-water port, such as New York City, the gangway from the float to the pier has varying inclines, depending upon the tide at the time of delivery (Pl. VI, fig. 1). When the incline is fairly steep, a buffer of sand is used at the end of the plank on the pier to retard the speed of the truck. While the incline is a hazard, loss on this account is unusual. At high tide, egg cases may be delivered from the car on the float to the pier by means of a sliding chute (Pl. VI, fig. 2). The goods are stacked along both sides of the station pier, leaving a driveway down the center.

The private sidings at which the investigators worked were numerous and varied. Sometimes the cases were delivered at the sidewalk in front of a commission house, and conveyed on 4-wheeled trucks to the house. At other places the cases were conveyed from

a platform on trucks through long tunnels to private warehouses. In some instances the unloading was direct from the car on the same level as the house. This was especially true at platforms of cold-storage warehouses. Some of the warehouses used 4-wheeled trucks exclusively, while others used both 2-wheeled and 4-wheeled trucks. In one place, delivery was made direct from the cars on the float to a private warehouse. Whatever the manner of unloading happened to be, the experimental cases received exactly the same treatment as the other cases in the shipment.

Eggs received at various terminals in experimental shipments were examined individually, and charted on a diagram similar to that used by the investigators at the point of origin. A comparison of the two diagrams showed at a glance the damage which had occurred during transit to each individual egg in the case.

RESULTS OF THE INVESTIGATION.

FACTORS CONTRIBUTING TO TRANSIT DAMAGE.

A study of the conditions surrounding the transportation of eggs leads to the conclusion that the damage referable to transit may be reduced to less than 1 per cent, provided the eggs are shipped in carlots, packed in good, well-made, standard cases, with new medium or heavier fillers and flats, with properly placed and suitable cushions at top and bottom, and with cases tightly stowed and efficiently braced in the car. As a rule the average well-packed, well-handled carlot shipment shows a damage of less than 2 per cent.

TABLE 1.—*Damage in transit to eggs in well-stowed cars.*

Experiment No.	Damaged eggs per case.	Experiment No.	Damaged eggs per per case.
5117	2.0	5114	3.5
5118	3.5	5126	3.5
5120	3.0	5131	3.5
5121	1.5	5139	4.0
5122	2.0	5150	4.5
5124	2.0	5154	5.0
5127	2.5	5171	4.0
5129	4.5	5173	2.0
5130	3.0	5177	4.0
5132	5.0	5181	3.5
5135	3.0	5137	4.0
5104	3.0	5105	4.0
5172	5.0	5146	3.5

Table 1 shows the damage observed in some cars which, well stowed, buffed with either straw or wood, and well braced, traveled without any shifting of the load; all were handled during transit according to the usual railroad routine. Viewed from the aspect of eggs per case, the number is small. Viewed in the light of the egg trade in the United States, the damage is still sufficiently great to

warrant its analysis and further efforts to reduce it. Viewed with the remembrance of the much greater amount of damage constantly visible wherever egg cars are unloaded, it seems highly desirable to discuss and weigh the routine of handling, stowing, bracing, and transporting by which the damage was kept down to the figures given in Table 1.

An analysis of the factors contributing to transit damage shows that it is principally affected by:

(1) The size of the egg.
(2) The soundness of the eggshell.
(3) The character of the package.
(4) The position of the egg in the package.
(5) The position of the case in the car.
(6) The character of the buffing and bracing of the load.
(7) The construction of the car.
(8) Shocks during the haul.
(9) Handling at the terminal.

THE SIZE OF THE EGG.

The relative safety during transportation of eggs which exactly fit the cells of the fillers as they are now made (1.75 by 2.25 inches), as compared with eggs which are too long, too short, and too narrow, is shown in Table 2.

TABLE 2.—*Damage in transit to long, short, narrow, and well-fitting eggs.*

Condition at packing house.	Individual eggs.	Eggs damaged in transit.	
	Number.	*Number.*	*Per cent.*
Well-fitting	33,626	639	1.90
Long	323	12	3.71
Short	1,170	11	.94
Narrow	467	7	1.49

The eggs which are too long for the fillers are, of course, most subject to injury. The study indicates that 18 per cent of the eggs marketed in northern Missouri were longer than the cells. More than 2 per cent were $\frac{1}{8}$ inch or more above the top of the cell (fig. 7). The proportion of large eggs would probably increase in some districts, where production has been placed on a more scientific basis, and decrease in others, where low-grade stock still predominates.

The eggs which are too large for the diameter of the filler press the walls outward, and secure sufficient space from the cells containing narrow eggs; for the eggs which are too long there is no such relief, and their liability to damage is nearly twice that of the well-

fitting egg, even when, as in these experiments, care was taken to slant the egg into the most advantageous position. Figure 8 indicates the frequency of the occurrence of extra wide eggs.

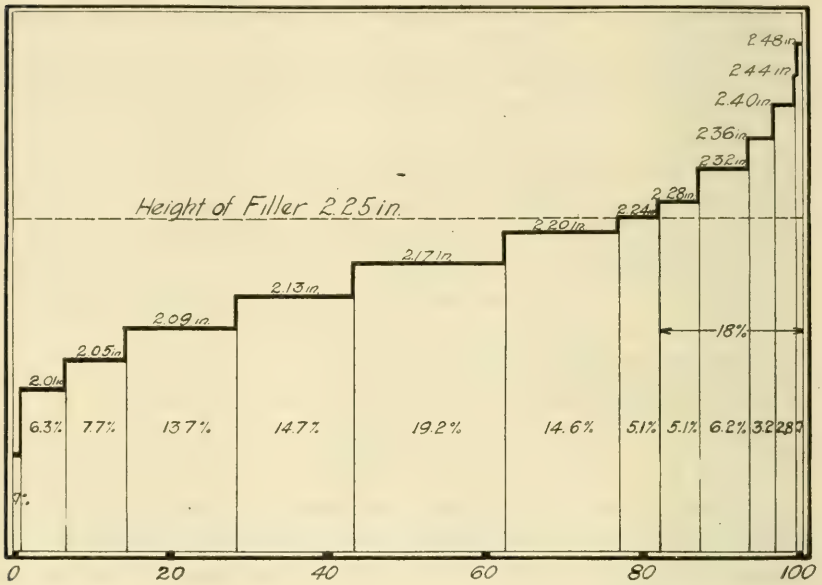

FIG. 7.—Relation of length of eggs to depth of fillers. Measurements made from 2,100 eggs.

THE SOUNDNESS OF THE EGGSHELL.

The number of eggs showing damage to the shell before shipment is given in Table 3. The presence of an average of 19 cracked eggs to the case, as it leaves the hands of the shipper, might lead to the inference that these eggs would be a fertile field for further and more

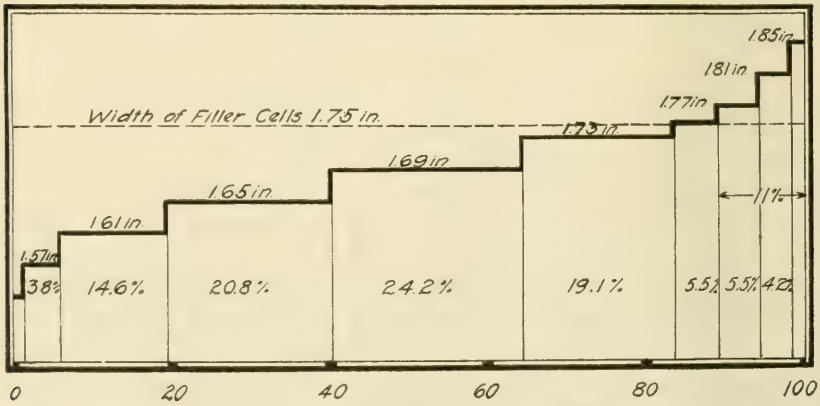

FIG. 8.—Relation of width of eggs to width of filler cells. Measurements made from 2,100 eggs.

serious damage during transit. It should be remembered, however, that these 19 eggs per case as they leave the shipper are not damaged to such an extent that they are detected in the usual terminal inspection, unless the inspection includes candling or clicking.

TABLE 3.—*Number of eggs with shells damaged before loading in car.*

Packing house No.	Number of experiments.	Number of eggs per case.							Total damaged eggs per case.
		Cracked.			Dents.			Total average damaged.	
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.		
									Per cent.
I	6	20.75	3.38	15.92	28.85	0.50	11.56	27.48	7.64
II	1	10.37	10.37	10.37	3.88	3.88	3.88	14.25	3.96
III	10	21.90	6.37	14.11	6.50	.25	2.56	16.67	4.63
IV	1	.....	.....	.....	2.00	2.00	2.00	2.00	.56
V	15	18.00	4.33	10.00	12.67	3.00	8.11	18.11	5.03
VI	7	17.00	8.67	11.60	10.00	5.67	8.14	19.74	5.49
VII	11	23.75	11.25	19.30	8.63	.63	3.85	23.15	6.43
VIII	8	23.60	16.75	19.48	5.00	.75	2.45	21.93	6.09
IX	1	19.10	19.10	19.10	1.00	1.00	1.00	20.10	5.59
X	1	10.50	10.50	10.50	.63	.63	.63	11.13	3.09
XI	1	10.75	10.75	10.75	.75	.75	.75	11.50	3.20
XII	2	8.75	8.25	8.50	.75	.25	.50	9.00	2.50
XIII	1	12.75	12.75	12.75	2.25	2.25	2.25	15.00	4.17
XIV	1	12.25	12.25	12.25	.75	.75	.75	13.00	3.61
XV	8	20.40	8.67	14.80	6.00	.....	2.85	17.65	4.90
XVI	2	23.00	15.50	19.25	1.50	1.25	1.38	20.63	5.72
XVII	8	23.00	8.88	17.10	.88	.29	.57	17.67	4.91
XVIII	7	23.00	.75	15.00	3.50	.....	1.76	16.76	4.65
XIX	3	30.9	25.1	27.03	3.38	.75	2.46	29.49	8.20
XX	1	1.90	1.90	1.90	2.00	2.00	2.00	3.90	1.08
XXI	2	34.50	23.60	29.05	3.12	2.00	2.56	31.61	8.78
XXII	1	20.70	20.70	20.70	4.75	4.75	4.75	25.45	7.07
XXIII	1	18.30	18.30	18.30	3.63	3.63	3.63	21.93	6.08
XXIV	1	4.00	4.00	4.00	19.67	19.67	19.67	23.67	6.58
XXV	3	17.67	6.00	13.78	15.30	6.67	9.88	22.66	6.30
XXVI	5	16.00	5.67	9.73	19.67	6.33	15.20	24.93	6.92
XXVII	20	16.00	7.33	12.70	13.00	.75	4.50	17.20	4.78
XXVIII	8	17.67	8.00	12.50	8.67	.38	3.74	16.24	4.50
XXIX	1	6.00	6.00	6.00	5.00	5.00	5.00	11.00	3.06
XXX	9	26.40	5.00	16.20	5.67	.....	.96	17.16	4.78
XXXI	1	4.33	4.33	4.33	.67	.67	.67	5.00	1.39
All packing houses	147	34.50	.....	15.38	28.85	.....	4.03	19.41	5.39

To determine the extent of the damage when the lightly cracked or dented eggs were well packed and well stowed, a comparison was made of the injury to sound and unsound eggs. The results are given in Table 4.

TABLE 4.—*Damage in transit to sound and unsound eggs.*

Condition at packing house.	Individual eggs.	Eggs damaged in transit.	
	Number.	*Number.*	*Per cent.*
Sound shells	76,386	1,162	1.77
Cracks	4,368	125	2.88
Dents	972	22	2.37

Little difference is shown between the amount of injury to checks and that to dents, when the shell membranes are not broken. There

is, however, a distinct difference, approximately 1.1 per cent, between the sound and the unsound eggs. This figure, applied to case lots of unsound eggs, shows an additional damage having a commercial importance. Applied, however, to the case of rehandled eggs as commonly put up by the shipper, containing 19 with unsound shells, it amounts to only 0.2 egg per case, a negligible number. Apparently, then, the matter of the 19 cracked eggs, as found in the well packed standard package, becomes an economic question of keeping quality in cold storage and of marketing, not of transportation damage.

THE CHARACTER OF THE PACKAGE.

Strength of cases.—In the course of this investigation the standard egg package was subjected to various tests[1] to determine the relative strength of the three kinds of wood (gum, tupelo, and cottonwood) commonly used, the number of nails needed, the manner in which the cases failed when subjected to evenly exerted pressures, and to obtain other data bearing on the subject. A summary of results, the details of which are too lengthy to be included here, is presented in this bulletin. Table 5 gives the average number of pounds of evenly applied pressure which the different cases withstood before they failed or became crushed.

TABLE 5.—*Analysis of strength of egg cases.*

Material.	Type.	Strength.				Weight.
		Diagonal.	Lengthwise.	Sidewise.	Vertical.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Cottonwood	5 nails	590	2,214	9,810	20,343	7.25
Red gum	do	567	2,110	13,629	21,257	8.89
Tupelo	do	687	1,914	12,143	20,294	8.24

In spite of greater weight, the gum and tupelo cases offer no additional strength as compared with cottonwood. On the other hand, cottonwood presents certain advantages in that it is softer and odorless, and does not warp or crack as readily as the other woods. The results given in Table 5 are based on cases made up with 5 cement-coated 3-penny nails at each corner of the sides and bottom and at the center partition. If only 4 cement-coated nails are used the package is weakened; this was also the case with smooth nails, even when 5 were used. The use of 6 cement-coated 3-penny nails slightly increases the rigidity of the case, an important feature in safe transportation, since distortion of the case soon causes breakage. The same added rigidity is noticed when wire binding is used around the sides and bottom of the case at the ends; likewise when the lid is nailed in the center.

[1] The tests were made in cooperation with the Forest Products Laboratory, of the U. S. Department of Agriculture, and the Bureau of Standards, of the U. S. Department of Commerce.

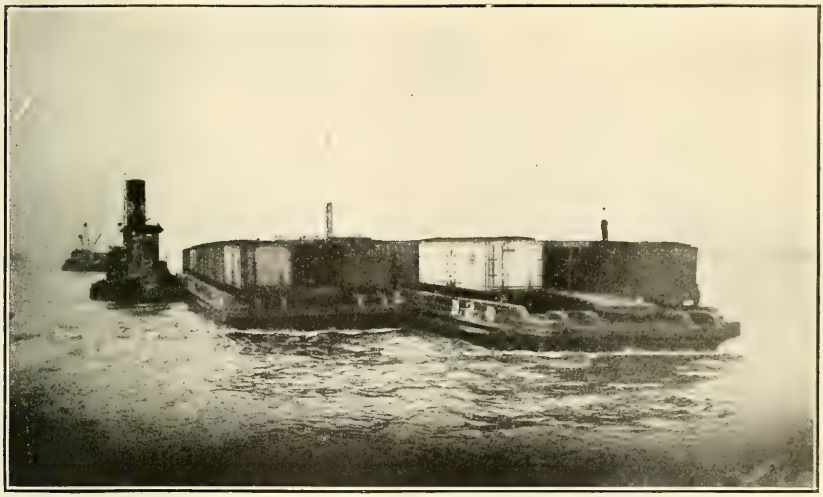

FIG. 1.—FLOATS CROSSING NORTH RIVER TO NEW YORK CITY.

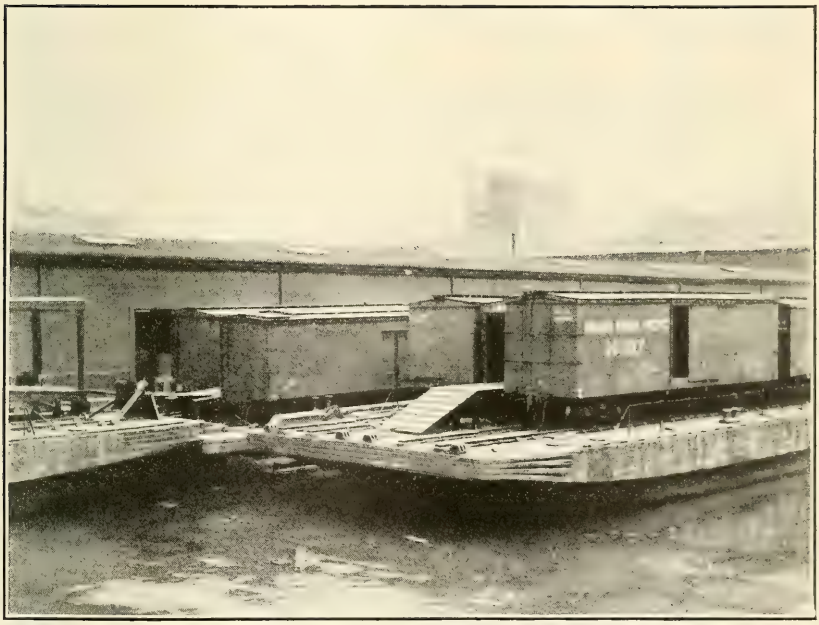

FIG. 2.—FLOATS FASTENED TO THE PIER, NEW YORK CITY.

FIG. 1.—HIGH TIDE AT A STATION PIER.

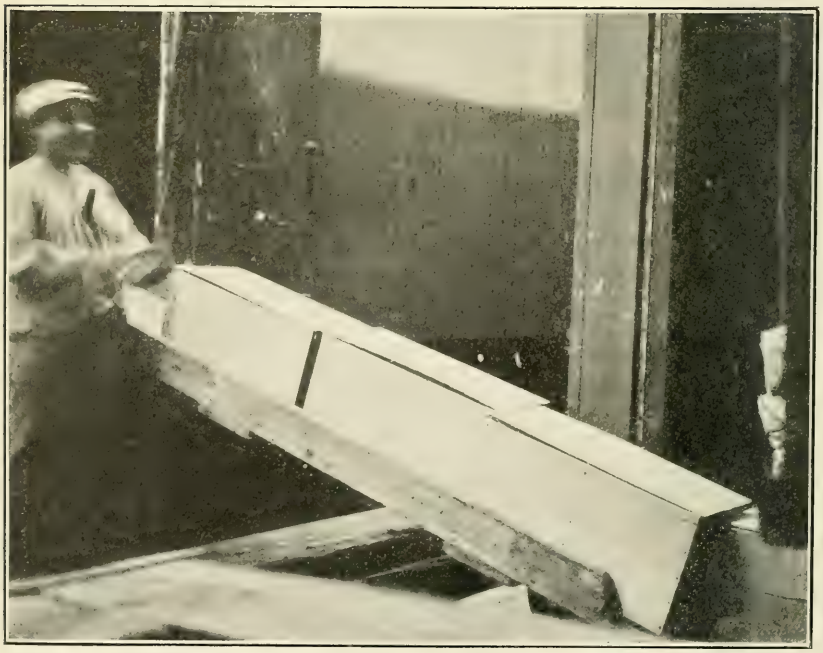

FIG. 2.—UNLOADING AT A PIER THROUGH A CHUTE.

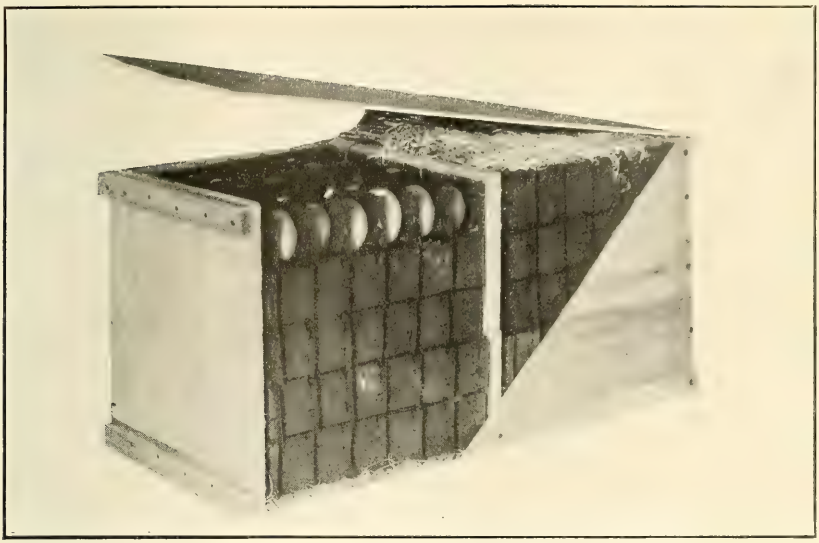

FIG. 1.—EXCELSIOR WELL PLACED.

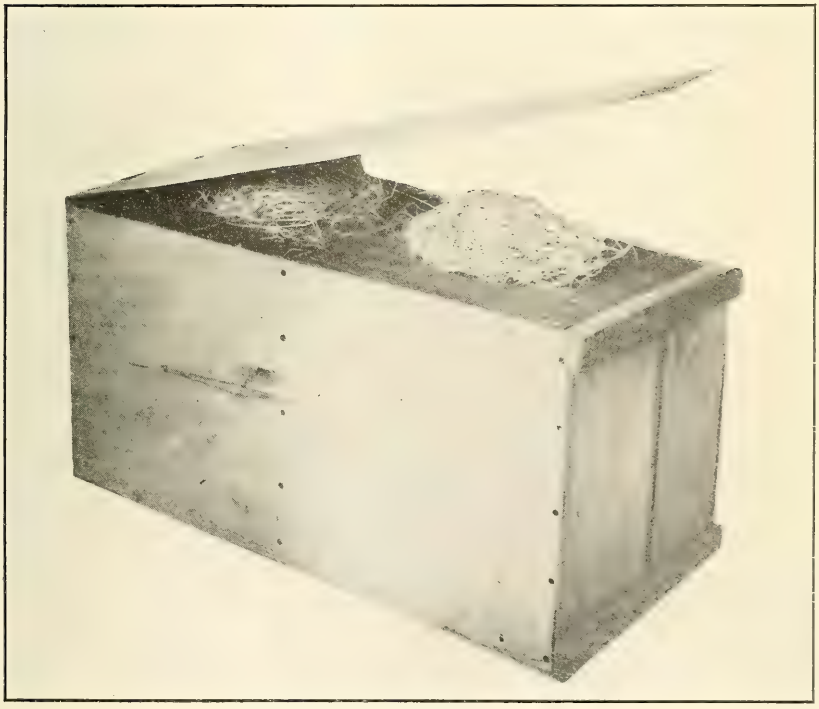

FIG. 2.—EXCELSIOR BADLY PLACED.

FIG. 1.—STRAW BUFFING LOOSE; LOAD SHIFTED.

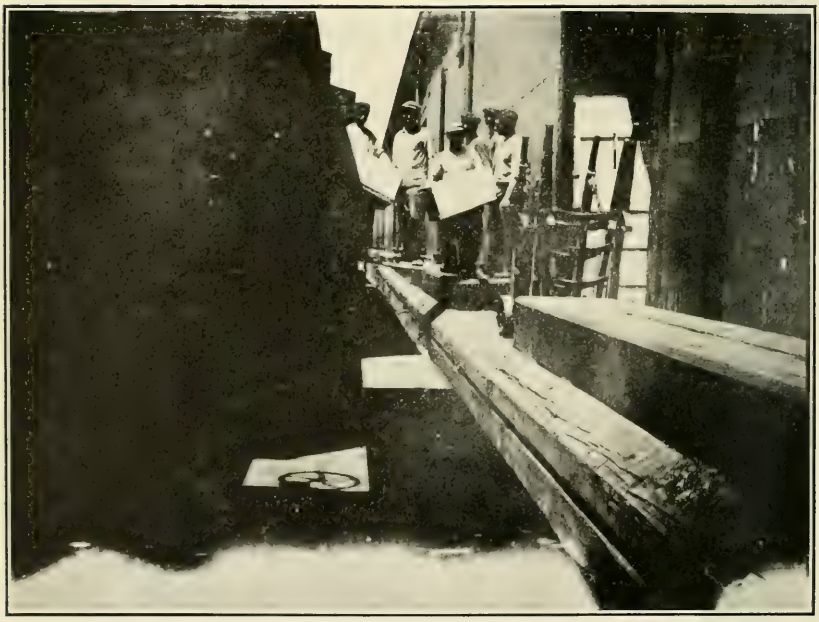

FIG. 2.—CONGESTION AT A STATION PIER.

Strength of fillers.—The strength of various grades of strawboard fillers on the market was accurately measured in compression machines, and, as indicated in Table 6, it varies with their respective weights.

TABLE 6.—*Crushing strength of fillers.*

Trade name.	Weight per set.		Crushing strength.	Strength of tips.
	Pounds.	*Ounces.*	*Pounds.*	*Pounds.*
No. 1	3	12	685	57
3 pounds	3	6	595	42
Medium	3	3	471	38
No. 2	2	8	325	36

The strength of the tips of the fillers was obtained by subjecting them to pressure in a like manner. The close relationship between filler tips and damaged eggs is seen throughout this investigation. It has been observed in field work, and amply proven in the laboratory. For example, the effect of measured blows delivered in a definite way against the end of the case did not wreck the shell of the egg until the tips of the fillers were bent so that the sides of the strawboard cell came in contact with the wood of the case. The tips of the so-called No. 1 fillers were found to protect the eggs on the ends from becoming leakers more effectively than 3-pound or medium fillers, but heavy shocks were observed to cause a light cracking before these heavy tips failed.

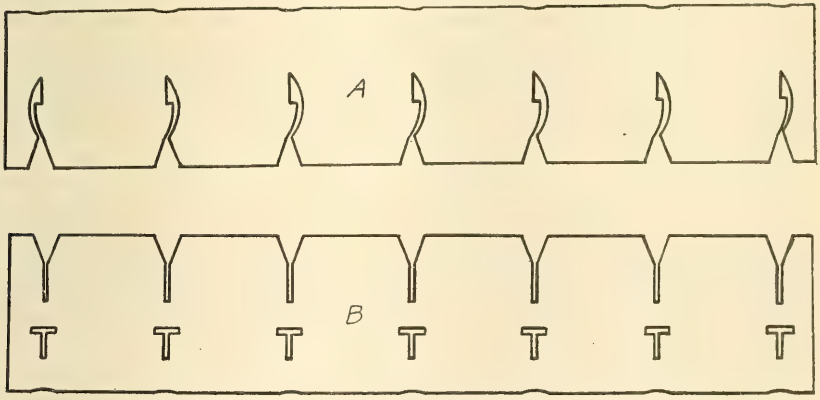

FIG. 9.—Longitudinal and transverse sections of an egg filler.

The strips which form the cell walls of an egg filler are solid (B) on one side and slit (A) on the other (fig. 9). When the filler is completed, half of the solid sides are upward in the filler, and the other half, running in a transverse direction, are downward. Added safety is gained by placing the upper solid side next to the end and center board of the case, as this prevents the egg from toppling over against the wood.

The increased protection afforded by strictly new, as compared with old, fillers is strikingly brought out in the laboratory tests, as well as under practical conditions. Of course, there is a wide variation in old fillers, if all fillers which have been used are so designated. Taking fillers which are distinctly defective, in having some bent and more or less softened tips, the damage is frequently five times that in new fillers. For example, 99 foot-pounds of energy delivered in the form of two blows, evenly distributed over the end of a case having 6 inches of sliding room, crushed 6.5 per cent of the eggs in old fillers, while the same treatment crushed only 1 per cent of the eggs packed in perfectly new fillers. Such results indicate that much stress should be laid upon the importance of new fillers in the safe shipping of eggs.

Top and bottom cushions.—The quarter filler recently brought into use as a cushion in the bottom of the egg case will support an evenly applied weight of 900 pounds, which is amply adequate to carry the load to which it is subjected. It provides a perfectly even cushion, another essential in securing safe transportation of eggs. If the bottom of the case becomes wet, this quarter filler is likely to flatten out, ceasing to act as a cushion. When excelsior is used as a bottom cushion it must be plentiful and evenly distributed, and a flat must always be laid over it before inserting the first filler. A comparison of the efficiency of corrugated flats and properly applied excelsior as a cushion in the top of egg cases showed that they afforded practically the same protection. Excelsior must be laid evenly over the top flat, and must be sufficient to fill the space in the top of the case, but not enough to cause a bulging of the lid. In no case should a wad of excelsior be placed on the center of the top flat (Pl. VII).

THE POSITION OF THE EGG IN THE PACKAGE.

Practical experience has shown that damage to the eggshell is more common in the rows next to the ends and center and in the top layer than in those deeper in the case. The relative safety of the different rows is seen from the data given in Table 7.

TABLE 7.—*Damage in different rows in the case.*

Description of cars.	Section of case.			
	End.	Second row.	Third row.	Center.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Straw buffed	1.39	1.04	0.95	0.97
Wood buffed	1.64	1.44	1.17	1.30
Poorly loaded	2.95	2.04	1.73	1.46

The center partition may be considered to form one end of the case. When a shock is received on the end of the case, it is transmitted to the eggs through the filler tips, if they are not bent, or through the walls of the cell, forcing the entire 15 dozen eggs back against the center board, where, again, the tips of the fillers are called upon to afford protection. If the tips fail, the eggs come into sharp contact with the case itself, and damage results. The extent of the damage at the center board is less than at the end of the case, due probably to the absorption of a certain amount of the shock by the packing and load of the case.

It will be observed that cars which were not well loaded show a greater amount of damage in each row, but that a difference between the end and the center board is maintained. Experimental observations in the testing laboratory have fully confirmed the records of the experimental shipments. The damage occurring in the different layers of the case is summarized in Table 8.

TABLE 8.—*Damage in various layers in the case.*

Description of cars.	Layer.				
	Top.	Second.	Third.	Fourth.	Fifth.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Straw buffed	1.41	1.11	1.11	0.84	1.05
Wood buffed	2.46	1.35	1.42	1.10	1.04
Poorly loaded	3.06	1.91	1.39	1.50	1.87

Many factors may contribute to increase the breakage in the top layer. Among them are walking on cases or climbing over them, an inadequate cushion, or the throwing of the eggs against the lid of the case during severe jolts. Experimental work in the testing laboratory indicated that the damage in the top layer caused by definitely administered shocks on the end of the case amounted to approximately 40 per cent of the total damage in the whole case. It is of interest to observe in Table 8 that damage, unless almost negligible, as in straw-buffed, well loaded cars, is approximately twice as heavy in the top layer as in any of the lower layers.

The question of buffing in the ends of the cases was also studied in the testing laboratory. If the center partition is properly placed, and the fillers and flats fit the cases, excelsior wads, corrugated flats, or other buffing is not needed, and does not afford additional protection. Improperly placed center boards or fillers that are either too large or too small are a prolific source of damage, and buffing in the ends of the cases can not be relied upon to afford adequate protection.

THE POSITION OF THE CASE IN THE CAR.

The data on the damage to the eggs, due to the part of the car in which the case is placed, are given in Table 9. These data are compiled for well and poorly loaded cars, and for both straw- and wood-buffed cars. In the straw-buffed cars, as the distance from the straw buffing increases, there is a slight but definite increase in breakage, amounting to about 1 egg per case. Although this increase is not visible in the wood-buffed loads, the total breakage with this form of buffing is slightly higher. Regardless of their position the rows show a uniform tendency toward an increased damage along the sides of the cars, becoming progressively less toward the center line. The layers of cases show no consistent tendency toward increased damage in any definite locality.

TABLE 9.—*Transit damage to eggs in different parts of the car.*

Description of car.	Stacks.						
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Straw buffed	0.69	0.88	0.73	0.90	0.84	0.90	1.06
Wood buffed	1.18	1.32	1.52	1.36	1.82	1.25	1.08
Poorly loaded	2.08	1.07	1.62	.....	.88	1.72	2.40

Description of car.	Rows.				Layers.			
	Side wall.	Second.	Third.	Fourth.	Bottom.	Second.	Third.	Fourth.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Straw buffed	0.84	0.90	0.84	0.84	0.75	1.00	0.75	0.84
Wood buffed	1.60	1.36	1.32	1.28	1.24	1.07	1.25	1.90
Poorly loaded	1.68	1.60	1.50	1.40	1.50	1.40	1.94	1.18

THE CHARACTER OF THE BUFFING AND BRACING OF THE LOAD.

A correlation of the character of the stowing of the load at the point of origin and its effect on the amount of damage to the eggs apparent at destination soon convinced the investigators that a revision of many common practices must occur before any noteworthy improvement in the condition of the eggs at the market center could be expected.

The experiments here reported indicate that the load of egg cases must be a solid unit in the car, fitting in so tightly that not an inch of play is available, and its rigidity must be entirely independent of braces nailed to any part of the car. How such stowing and bracing can be readily and cheaply done is told on pages 5 to 9 of this report. Of all the various factors entering into the breakage of eggs during transportation, the placing of the load in the car and the maintenance of its rigidity during transit are the most important.

The damage in a number of cars, typifying good bracing, buffing, and stowing, is shown in Table 1. Table 10 shows the damage in some individual cars which were not stowed tightly enough to prevent a certain amount of shifting. In these cars, the shifting of the load was plainly visible on arrival at destination, and even before that time they had been classed as "poorly loaded" by the investigators in the producing territory. In no case, however, were these cars comparable with those known commercially as "in bad order," and none of them contained cases stained on the outside by liquid egg. In the language of the trade, there was no "visible damage." They are given here to illustrate how rapidly damage increases after the occurrence of a noticeable shifting, not as examples of the amount of damage often seen in cars commercially loaded.

TABLE 10.—*Damage in transit due to poorly stowed cars.*

Experiment No.	Damaged eggs per case.	Experiment No.	Damaged eggs per case.
5111	7.5	5141	9.0
5161	8.0	5180	9.5
5106	6.5	5107	7.0
5156	12.5	5165	9.5
5176	14.5	5186	7.5

A comparative study of the step-joint and straight-joint loads indicates that, all other conditions being equal, one is as efficient as the other, in so far as the safety of the eggs is concerned. Table 11 gives the damage in typical cars, when both forms of placing the cases were used, and when the buffing and bracing prevented the shifting of the cases during transit shocks.

TABLE 11.—*The relative damage in step-joint and straight-joint loads.*

Step-joint loads.		Straight-joint loads.	
Experiment No.	Damaged eggs per case.	Experiment No.	Damaged eggs per case.
5122	2.0	5121	1.5
5126	3.5	5124	2.0
5130	3.0	5114	3.5
5137	4.0	5117	2.0
5127	2.5	5118	3.5
5135	3.0	5120	3.0
5131	3.5	5129	4.5
5150	4.5	5139	4.0
5116	2.5	5171	4.0
5115	3.0	5173	2.0

During the early part of the investigation it was observed that while many step-joint loads showed damage at destination, they were

invariably so stowed that shifting of the load had occurred during transit. Later on, when the investigators saw to it that the load was rigid, the results given in Table 11 were obtained. When shifting in this load does take place the three crosswise cases on alternate layers at the bunker are likely to fall down into the space, not only becoming crushed themselves but by grinding injuring other cases.

The rigidity of the load depends largely upon the character of the buffing and the manner in which it is placed in the car; hence it assumes an important rôle in preventing damage. The methods used by the investigators, in order to make observations upon loads buffed with either straw or wood (pp. 6 and 7), emphasize the necessity of packing the buffing so tightly that shifting can not take place. Unfortunately many shippers have failed to realize the easily compressible character of straw, to which fact is due much of the damage prevailing in straw-buffed cars (Pl. VIII, fig. 1). For example, out of 27 straw-buffed carlots studied during the early part of the investigation 18 showed serious damage or displaced cases on arrival at destination, simply because the straw had not been packed tightly enough.

During the survey of commercial practices made in the early part of this investigation it was observed that a relatively large number of carloads of eggs buffed with wooden frames arrived at destination in good condition. This was because the load was tighter and had shifted little, if at all, as it did when loosely buffed with straw. Observations were made on a number of carlots that had been packed with straw at the bunkers, and the load then made tight by frames at the middle. These also commonly arrived in good order.

A comparison of the damage observed in well stowed cars, buffed with straw, with that in well stowed cars, buffed with wood, shows a small margin (about 1.5 eggs per case) in favor of the straw, as may be seen by comparing the typical shipments listed in Table 12.

TABLE 12.—*Comparison of damage in straw- and wood-buffed cars.*

Straw-buffed cars.		Wood-buffed cars.	
Experiment No.	Damaged eggs per case.	Experiment No.	Damaged eggs per case.
5130	3.0	5102	5.5
5118	3.5	5103	6.5
5120	3.0	5104	3.0
5132	5.0	5105	4.0
5181	3.5	5140	6.0
5173	2.0	5146	3.5
5127	2.5	5148	5.0
5129	4.5	5172	5.0

The amount of damage given in Table 12 is, of course, the average for all parts of the car. Reference to the discussion of the damage

in different parts of the car shows that the extra protection afforded by straw is largely distributed over the rows close to the straw, where apparently it visibly reduces the number of eggs broken. In the rows toward the middle of the car both forms of buffing, so long as the load is tight, are equally efficient.

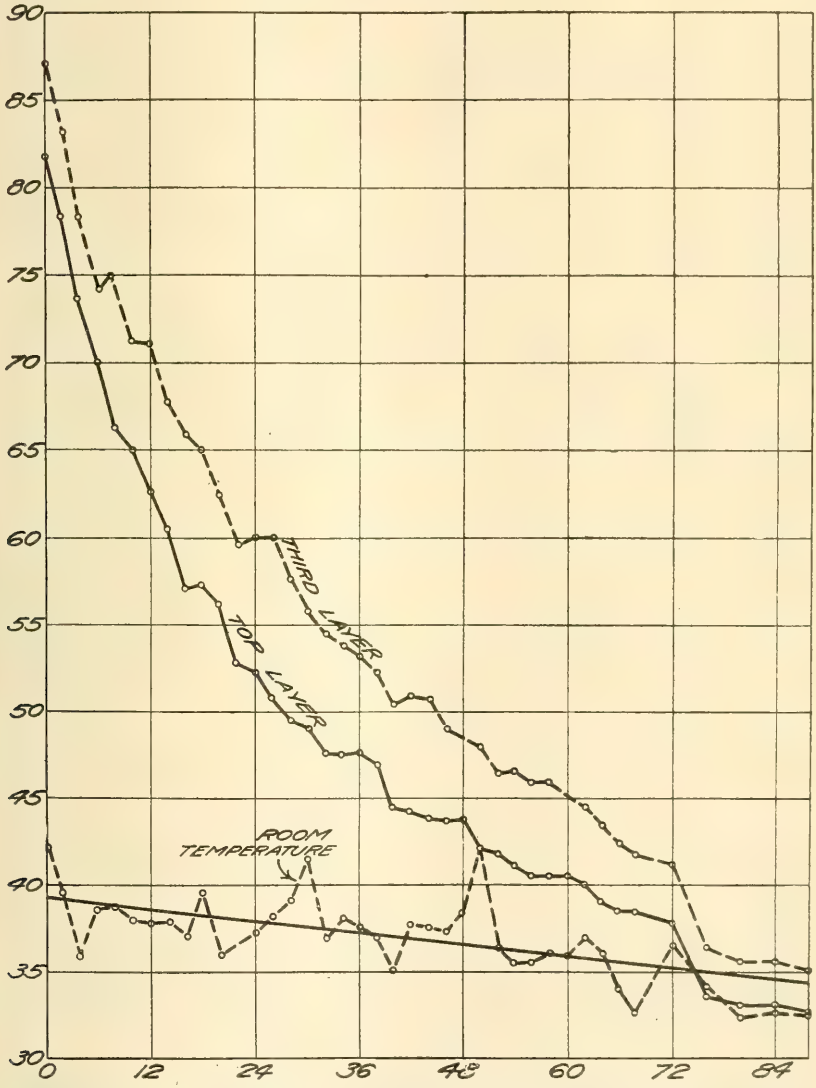

FIG. 10.—Rate of cooling of eggs in refrigerated storage room.

The effect of straw buffing on the temperatures maintained in refrigerator cars is too important to be omitted in a discussion of its relative value in the saving of waste in eggs. It is difficult to chill eggs packed in cases even when conditions are favorable. Figure 10

shows that in a mechanically refrigerated room about 72 hours were required to reduce the eggs in the center of the package from an

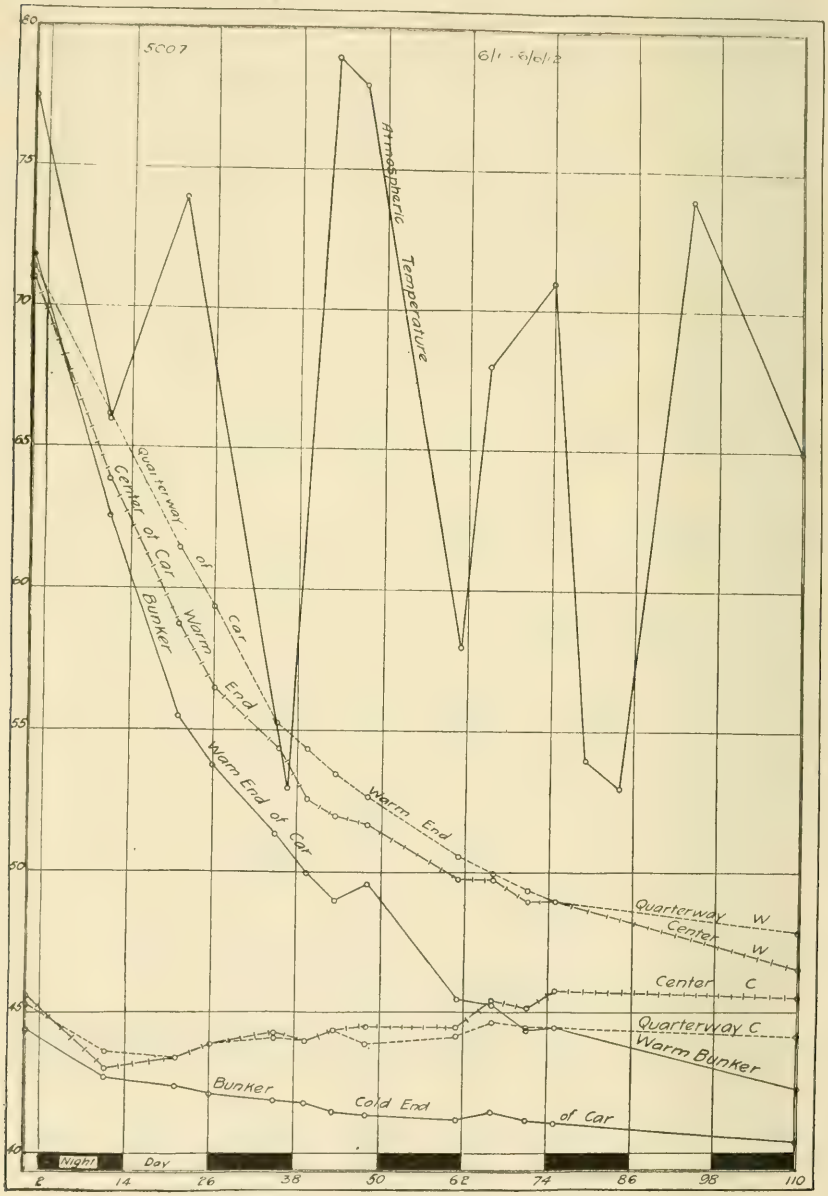

FIG. 11.—Rate of cooling of eggs in a refrigerator car.

entering temperature of 87° F. to 32° F., or the temperature of the room. Chilling in a good refrigerator car is, of necessity, a much slower process, as is illustrated in figure 11, which shows that 4.5

days were required to reduce the eggs from 73° F. to the temperature of the car, approximately 45° F. On the other hand, the maintenance of the desired temperature in precooled eggs is comparatively simple (fig. 11), experiments having shown that eggs reduced to a temperature of approximately 45° F. before loading maintained that temperature throughout the haul. The placing of straw buffing

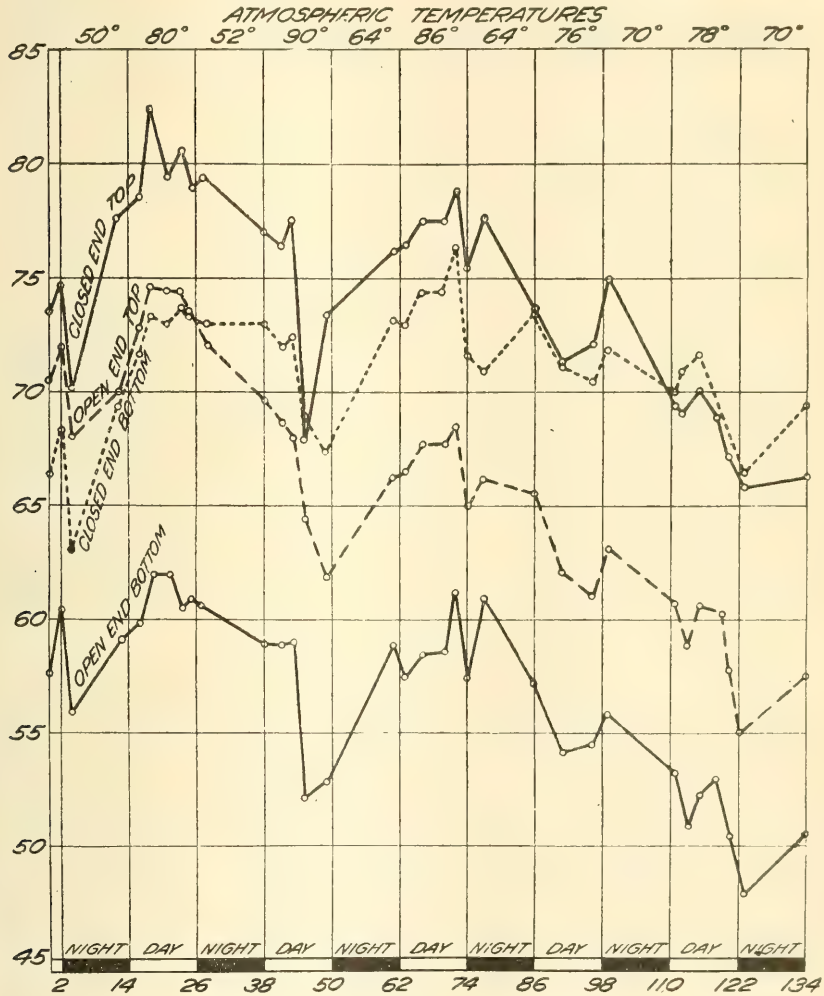

FIG. 12.—Car temperatures with open straw buffing and closed straw buffing.

from the top of the load to the floor of the car prevents the exit of cold air from the bunkers. To determine the extent of the loss of refrigeration under such conditions, temperatures were taken throughout the haul by means of electrical thermometers in cars having solid buffing at one end and a frame supporting the straw

(p. 7) at the other. The results are shown in figure 12, which indicates that approximately 50 per cent of the refrigeration available is lost by buffing solidly to the floor. During the early spring, when the weather is cool, this loss of refrigeration is not serious. When shipments are made in warm weather, however, it is a question which must be considered. The straw buffing, properly applied, may save damage to the shell of an egg or two per case, but if it permits of unchecked deterioration from heat it is of very doubtful economic value. Under warm weather conditions the shipper should consider the relative advantages of the small frame described in this report or of wood buffing.

If the load is to be a solid unit in the car, the form of brace to be used, in case the layers are not complete throughout, becomes an important matter. The mere weight of the cases in an incomplete top layer is not sufficient to keep them in place. In 16 of 36 such loads traced to the market serious damage occurred. Failure to brace an incomplete top layer, especially in mixed cars, is a frequent source of serious damage. A roaming case is not only damaged itself, but it damages other cases. The scantling braces nailed to the walls of the car seldom arrive in place. They should never be used. The most satisfactory braces found up to the present time are those described on page 8. It is readily seen that, if the load is to be a solid unit inside the car, the braces must be a part of the load itself, and must in no wise depend upon the car for resistance or strength. Nailed braces are a part of the car, not a part of the load.

THE CONSTRUCTION OF THE CAR.

Observations during yard shifting showed that freight cars having steel underframe construction do not react to shocks in the same way as do those having wooden underframes. Cars with wooden underframes give under impacts in such wise that the load receives less of a jolt than that in the steel-framed car. There is a slight increase in damage to eggshells when carried in steel underframe cars, all other conditions being equal, as shown in Table 13. This tendency is visible whether the load is buffed with wood or straw, or whether well or poorly stowed.

TABLE 13.—*Damage in cars with steel and wooden underframes.*

Steel straw-buffed car.		Wooden straw-buffed car.	
Experiment No.	Damaged eggs per case.	Experiment No.	Damaged eggs per case.
5114	3.5	5117	2.0
5126	3.5	5118	3.5
5131	3.5	5120	3.0
5139	4.0	5121	1.5
5150	4.5	5122	2.0
5154	5.0	5124	2.0
5171	4.0	5127	2.5
5173	2.0	5129	4.5
5174	6.5	5130	3.0
5177	4.0	5132	5.0
5181	3.5	5135	3.0
5183	6.0	5137	4.0

SHOCKS DURING THE HAUL.

This report does not attempt to locate any damage prior to the receipt of the eggs by the packer, although the transportation of eggs, from the viewpoint of damage, includes their transfer from the farm to the shipper, frequently via the country merchant or huckster, as well as the usage to which they are subjected after being cased by the shipper and en route to the consignee.

There is an opportunity for damage to the shells during the transfer from the packing house to the car, and again from the freight house at the terminal to the establishment of the consignee. Undoubtedly such damage sometimes occurs, but observations show that it is by no means so frequent as is commonly supposed. A comparison of breakage in shipments loaded directly from the packing house to the car, with only the width of the platform intervening, and in those transferred by wagon from the packing house to the loading platform showed practically no difference between the two. Approximately 65 per cent of the experimental shipments involved a wagon haul from the packing house to the car. The fact that the damage at destination is the same in either case confirms the finding of the investigators that where hauling is necessary it is ordinarily conducted in such fashion that breakage does not occur, provided the package is standard and well constructed. It is, of course, possible for careless handling and hauling of cases between the packing house and the car to cause damage.

It has been observed that the shocks received by cars are most severe during yard shifting. The relative intensity of shocks received during ordinary railroad handling are given in Plate IV, showing slow running, fast running, and yard shifting. The train which furnished these records was typical of our fast freight service.

Starting with but a few cars, it finally consisted of 65. Sometimes it attained a speed of 45 miles an hour. The special car under observation in this train contained 400 cases of eggs. It was of the wooden underframe type, with its load buffed with straw and braced with lateral braces under the cases. It traveled approximately 1,200 miles, transferring from western to eastern lines in the vicinity of Chicago. On arrival at the seaboard terminal the load had not shifted an inch, and the damage, including lightly checked eggs, was less than 3 eggs per case.

By actual observation of eggs in cases during the haul, by the condition of the cases and the eggs reaching the terminal, and by experimental work in the testing laboratory, it has been found that shocks have very little effect on the eggs unless the tips of the fillers break or bend, thereby permitting the wall of the filler to come in contact with the end or center partition of the case. Laboratory observations as well as those made under commercial conditions indicate that cases held rigidly permit less damage to their contents than when play is given. For example, when 296 foot-pounds of energy in the form of 6 blows had been distributed evenly over the end of a case held against a bumping post, 1.33 per cent, or approximately 5 eggs per case, were broken. Repeating the experiment, except that the case was placed 6 inches from the bumping post and hence traveled that distance after every blow, 12.22 per cent, or approximately 45 eggs per case, were damaged. In either case, damage was light until the tips of the fillers were distinctly bent. After they had flattened completely the eggshells were mashed. Apparently the same principles hold good when the cases in transit are subject to shocks; hence the need of strong filler tips, good, symmetrical cases, and tight stowing in the car.

HANDLING AT THE TERMINAL.

The terminal problem in most of the eastern cities in which the investigators handled shipments is very complex. Traffic has grown to such an extent that the terminal facilities are often inadequate for the proper handling of the volume received. Where congestion occurs (Pl. VIII, fig. 2), extra gangs are placed in houses and on piers already crowded, making confusion and haste unavoidable. In the height of the egg season in New York City, both sides of a station pier are, day after day, lined with floats, and the driveway is filled with wagons or trucks, while outside other wagons are waiting to get in. When the tide is high and the delivery plank is sharply inclined (Pl. VI, fig. 1), it would seem almost impossible to prevent serious loss. Nevertheless, damage of any sort at the terminal was very rarely found, and it was the opinion of the investigators who had followed all phases of the transporta-

tion of eggs that there is less damage at the destination than at any other point, considering the vast volume of goods handled.

As previously stated, the eggs under observation were treated exactly in accordance with the commercial routine, and the final examination was made when the commercial handling ceased, whether that was on the pier, in the freight yard, at the store of the consignee, or in a private warehouse. Damage due to a transfer from the pier to the store of the consignee or the private warehouse is much less than is commonly believed. The occasional dropping of a case or other mishap, serious in itself, is small when the huge volume of business handled each day is considered. A comparison between the handling at private warehouses and that at railroad terminals shows that while the railroad handling is usually more rapid, it compares favorably, on the whole, with the handling at private houses.

In order to obtain a definite idea of the actual damage caused by loading and unloading into wagons and hauling over rough city streets, eggs were followed from the store of the dealer to the warehouse where they were held in cold storage for several months, then back again by wagon to the store of the dealer. Each egg was examined before and after the double haul. The wagon was light; the load was heavy; the haul, 2 miles each way; the streets traversed were paved with cobblestones and were unusually rough; the handling at the warehouse included shifting to a second storage room and high stacking of cases. In spite of this excessive hauling and handling, the damage, as seen from Table 14, was only 3.5 eggs per case, or 0.97 per cent. This represents more than twice the amount of handling the egg cases ordinarily receive between the terminal and the store or warehouse. It may, then, be concluded that, with the allowance of 1 egg per case as experimental error, the damage due to the usual cartage is less than 1 cracked egg per case.

TABLE 14.—*Damage due to haul in light wagon over cobble-paved streets.*

Load No.	Number of individual eggs observed.	Eggs damaged.	
		Number per case.	Total.
1	1,080	3	8
2	3,240	5	44
3	5,400	3	42
4	5,400	3	43
5	5,400	2.5	38
6	5,400	4.5	65
7	5,400	4	53
8	5,400	4	57
9	5,400	5	77
10	5,400	3	49
11	2,160	3	18
12	3,240	3	25
13	4,320	3	37
14	4,320	3.5	41
15	4,320	2.4	29
16	4,320	2	26
17	4,320	3	35

SUMMARY.

(1) All the eggs observed during this investigation were rehandled and repacked at the packing house. They were put into new standard cases, with new medium (3 pounds, 3 ounces) fillers and flats. The work was done by the employees of the house. As the cases left the house they included approximately 5.39 per cent of lightly cracked and dented eggs. Leaking eggs were rarely found.

(2) All the shipments studied were in carlots. The average haul was over 1,200 miles. When the shipments arrived at destination each egg in the experimental cases was again individually examined, and its condition compared with that previously noted at the packing house. It was found that when eggs were shipped in carlots, packed in good, well-made, standard cases, with new medium or heavier fillers and flats, with properly placed and suitable cushions at top and bottom, with cases tightly stowed and efficiently braced in the car, and the car handled in accordance with good railroad practice, especially when switching, the total damage referable to transit was less than 2 per cent.

(3) The size of the egg influences its safety in transit. Eggs which were longer than the cells of the fillers showed 3.71 per cent damaged.

(4) The eggs with lightly cracked or dented shells, but with membrane unbroken, showed a transit damage of 2.88 per cent, as compared with 1.77 per cent for eggs with sound shells. Applied to case lots of broken eggs, the increased liability to damage is noteworthy. Applied to the 19 lightly cracked eggs in the rehandled and repacked case of commerce, the additional damage, referable to checks and dents, is $\frac{1}{5}$ egg per case.

(5) Egg cases must be standard, symmetrically made with 5, or preferably 6, 3-penny cement-coated nails at each corner of the sides and bottom and at the center partition. While cottonwood, gum, and tupelo cases vary but little in strength, the cottonwood case has, on the whole, the greatest number of advantages.

(6) Medium fillers (3 pounds, 3 ounces) or heavier should be used. It is absolutely necessary that the filler be perfectly new. Even a short-haul shipment into the packing house should disqualify the filler for further use.

(7) Suitable cushions of excelsior, with a flat, should be placed on the top and bottom of the case. The quarter filler is strong enough, and it forms an even cushion. Corrugated board on the top of the case affords practically the same protection as the excelsior cushion, provided it takes up the slack.

(8) More damage occurs in the top layer of eggs than in the deeper layers of the case, and more in the ends than toward the center.

(9) When cars are buffed with straw at the bunkers there is a slight but clear rise in damage as the cases near the center of the car. There is also a progressively increasing breakage in the rows as they progress from the middle line to the side of the car. The location of layers is apparently immaterial.

(10) The load of eggs must be a solid unit in the car, fitting without play. This is the most important factor in avoiding damage in transit. Either the step-joint or straight-joint load may be used.

(11) The amount of damage in properly loaded cars buffed with straw is slightly less than in the same cars buffed with wood.

(12) When the straw buffing is placed at the bunkers and extends from the top of the load to the floor of the car, at least 50 per cent of the refrigeration is lost.

(13) Braces nailed to the car seldom arrive in place. They cause much damage. Self-bracing of the load by means of suitable strips placed below the cases is most satisfactory.

(14) Cars having steel underframes show a slightly greater amount of damage than those with wooden underframes.

(15) The shocks incident to ordinary freight train handling while running seldom cause damage in well-stowed cars. The shocks incident to switching are sometimes destructive. More care should be exercised in switching cars containing eggs.

(16) While the haul in wagons or trucks between the railroad terminal and the warehouse or store may be responsible for some damaged eggs, the breakage is ordinarily not more than 1 cracked egg per case.

(17) By following good commercially practicable methods of packing, storing, and hauling, eggs can be transported in carlots with a total damage of less than 2 per cent. Under "experimental" handling, where the work is of a high grade, though still following the commercial routine, the total damage can be reduced to less than 1 per cent.

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STATUS OF FARMING IN THE LOWER RIO GRANDE IRRIGATED DISTRICT OF TEXAS.

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DESCRIPTION OF AREA.

The present irrigable lands of the lower Rio Grande district are located in the southern portions of Cameron and Hidalgo Counties, in the extreme southern part of Texas. Brownsville, the largest city, is 372 miles southwest of Houston. (See fig. 1.)

FIG. 1.—Location of the lower Rio Grande irrigated district, Tex. (shaded area).

FIG. 2.—A main canal. This is the common type of ditch which conducts water from the river to the farms. Note the native vegetation and the wild state of the country before development.

The greater portion of the land in its natural state is covered with a considerable growth of mesquite, huisache, ebony, cactus, and other trees and shrubs (see fig. 2). The alluvial or lower-lying soils generally support a heavier growth than the lighter textured soils in the northern and western portions of the area.

The topography of the region (see fig. 3) is level to undulating. In general the land bordering the stream channels or "resacas" is slightly higher than that at a distance, due to overflows and the resulting deposit of sediment near the channels. The elevation varies from about 30 feet above sea level in the vicinity of Brownsville to about 250 feet north of Mission in the western part of the region.

The drainage of the region is not generally good. The lower lands in the eastern portions, many of which have heavy types of soil, are not so well drained as the lighter textured soils of Hidalgo County. On account of the fact that the banks of the Rio Grande and other channels are higher than the bordering land, the surface water has little opportunity to drain away, so that after heavy rains or excessive irrigation water stands in small lakes or ponds for considerable periods. However, the higher land outside of the delta formation has fairly good drainage owing to its comparatively steep slope.

Artificial drainage by means of surface ditches is being undertaken, particularly in Cameron County. Drainage districts have been formed, and bonds have been issued providing the funds for the ditch construction. The facilities now provided are improving the conditions, and it is only a question of time when artificial drainage will cover practically the whole region.

In many local areas where open-ditch drainage facilities have been provided but have not proved adequate, tile drainage has been substituted and is meeting the difficulties where satisfactory outlets may be had. It has been clearly demonstrated here, as elsewhere, that

where natural drainage is not exceptionally good artificial drainage must be provided where irrigation is practiced extensively.

The soils of the region are generally alluvial in origin and are exceedingly varied in character. There are low-lying areas that are poorly drained and are permeated with alkali, but the greater portion of the land is fertile and produces good crops when proper cultural methods are followed.

FARM FACTS.

During 1914–15 the writer visited several hundred farms in the lower Rio Grande district and secured information from the farmers themselves relating to the farm enterprises. The following pages give some data from the detailed study of these enterprises as well as of the entire business of 59 farms of the region, distributed from a point below Brownsville to a point north of Mission, a distance of about 70 miles. These farms are classified according to type as follows: Twenty-six truck farms, 16 stock farms, and 17 staple crop farms.

SIZE OF FARMS.

The farms studied vary in size from 10 acres of crop land to 200 acres, with an average of 59 acres, or 73 acres of total farm area. The area of crop land in this region does not always measure the size of the business on account of the difference in intensity of the various types of farms. When total expenses are used as a measure of size it is found that while staple crop farms average 87 acres as compared with 63 acres for truck farms, the expenses of operation of the truck farms are nearly $1,000 greater per year than those for staple crop farms.

FIG. 3.—A lateral irrigation ditch on a farm. The ditches are sometimes plowed down and reconstructed annually in place of cleaning them. Lettuce borders this lateral.

It appears that farms of less than 40 acres are not large enough in general for any type of farm. In fact the larger the size of farm, the greater is the amount of profit under average conditions, at least, to the point where the operator can properly supervise the farm operations.

INVESTMENT PER FARM.

The average farm of 59 acres of crop land when developed represents a total investment of approximately $14,000. Land represents slightly more than $10,000; dwelling, $800; barns and other buildings, $400; stock (including work stock,) $1,400 and cash on hand for running expenses, $350.

The investment in real estate is somewhat greater acre for acre on farms that are developed for truck raising. The average acre value of truck farms is $184, of stock farms $145, and of staple crop farms $130.

The value of work stock per head increases when the size of farm increases, indicating that a better quality of work animals is utilized on the larger farms. Approximately the same investment in machinery and tools is found on all types of farm, of the same size, but the investment is greater on the larger farms than on the small ones, and this machinery is more efficiently utilized on the larger farms.

LAND CLEARING.

The greater number of investors in farms at present buy uncleared land. The removal of the vegetation (see fig. 2) is the first step toward the development of the farm. This clearing is usually done by Mexicans under contract, which is cheaper than by day labor. The cost of clearing varies widely, depending upon the character and quantity of vegetation, the range on 52 farms being from $5 to $25 per acre with an average of $11.65.

After the land is cleared it generally requires some labor for leveling. The tendency up to the present has been to give little attention to this matter. In order that land may be properly irrigated it must be level or have an even slope. The leveling is generally done in connection with the first breaking of the land, the average cost of the combined operations on 51 farms being $4.75, ranging from $2 to $18 per acre. Even a greater expense for leveling at this stage of development is justified, since it represents a saving in labor and an increase in production during the following crop seasons.

DITCH CONSTRUCTION.

The companies usually conduct the irrigation water to the farms through their main canals and laterals (see fig. 2). The farmer must construct the laterals (see fig. 4) for his own farm. A small farm level is an excellent investment for the purpose of laying out these

ditches as well as for leveling. The cost of construction of these ditches varies according to the lay of the land, ranging on 38 farms visited from $0.25 to $32 per acre, with an average of $2.25.

DITCH MAINTENANCE.

The irrigation water frequently carries mud in suspension, some of which is deposited in the canals. Weeds and grasses make luxuriant growth in the ditches, owing to abundance of moisture. These obstructions in the laterals are effective in hindering the passage of water so that the ditches must be cleaned annually. This is accomplished with a shovel or spade. Frequently a plow is run through the ditches to loosen the soil and weeds.

Where the ditches on the farm are small they are frequently plowed down entirely with the fields and are then reconstructed with the use of plows and pushes, most of the work being done by horsepower. (See fig. 3.)

The annual cost of maintenance of the lateral ditches on the farm varies widely, depending upon the number and character of the ditches. On some farms the cost is as low as $0.10 to $0.25 per acre, while on others it is as much as $2 per acre. The average cost as estimated by 32 farmers is approximately $0.65 per acre.

AVAILABLE TIME FOR FARM WORK.

Field work can be carried on during all months of the year, practically the only limiting factor being an excess of rainfall. The number of work days per month varies from about 19 in June and September to about 25 in July and August. There are approximately 256 days available for field work per year.

There is not a wide variation in the number of hours per day that field work is done, about 10 hours being the average. It is customary for both teams and men to rest for about two hours during the middle of the day during the warmer summer months.

LABOR UTILIZATION ON FARMS OF DIFFERENT TYPES.

Much more man labor is used on truck farms than on farms of other types, owing to the greater intensity of cropping. Slightly more horse labor is used per acre on truck farms than on others. The number of acres per work animal (acres of crops divided by number of work stock) is decidedly less on truck farms than on others. The average number of acres per work animal on the farms of different types is as follows: Truck farms, 14; stock farms, 17; and staple-crop farms, 18.

The cost of man labor per day is practically the same on farms of different types but the cost of horse labor per day is greatest on truck

farms, owing to poor utilization. On the average truck farm the cost of horse labor per day is $1.18; on stock farms, $1; and on staple-crop farms, $0.96.

COST OF WORK STOCK.

The average annual cost of maintaining work stock is $106 per head, which includes value of feed consumed, depreciation, interest, etc. The value of feed consumed per animal is approximately $90 per head.

There are nearly three times as many mules as horses utilized on the farms of the region. The average value of 75 horses encountered is $102 per head; of 196 mules, the average value is $143 per head. On farms averaging 31 acres of crop land the average value of horses is $96, and of mules $123. On large farms of 82 acres of crop land horses average in value $110 per head and mules $155. The value of feed consumed per head on the same farms increases from $72 to $96 as the size of farm increases.

DOUBLE CROPPING.

One of the most important factors affecting profits is the ability of farm operators to produce more than one crop on the same land during the same year. All farmers produce corn or other staple crops, but many do not produce second crops on this land during the same year. On 12 of the 59 farms studied no second crops were produced, and returns of but 2.4 per cent on the investment were made, while on 24 farms an average of more than one-half of the land produced a second crop during the same year. These 24 farms made average net incomes more than four times as great as those doing no double cropping.

The staple crops are essential to the stability of the farm business, but the truck crops when successful are much more profitable. The second or truck crops should be diversified in character, as any one crop of this class may be a failure, owing to market conditions or other causes, while others are entirely successful.

Double cropping is of prime importance to profitable farming in the lower Rio Grande irrigated district.

INCOMES ON IRRIGATED FARMS.

The average farm income (difference between expenses and receipts) of the 59 farms studied is $1,471. To find the net profit there must be deducted from this the value of supervision by the operator. The farms average in net returns 6.3 per cent on the investment.

The percentage return on investment is approximately the same for groups of farms of different sizes; however, the farm income increases when the size increases.

The amount of double cropping determines largely the type of farm as between truck and staple crop farms. The average returns of 26 truck farms which get 40 per cent or more of their receipts from the sale of truck is 8.7 per cent on the investment. The average net returns of 17 staple crop farms is 3.9 per cent on the investment. The average farm income of 16 stock farms is $1,281; these farms make net returns of 5 per cent on the investment.

DEPENDABILITY OF ENTERPRISES.

In a region of such mild climate there is naturally a wide range of enterprises that may be operated on each farm. That considerable diversification of enterprises leads to greater profits is apparent from the foregoing pages. There is much more risk involved in some of the truck enterprises than in some of the staple crops or in stock production, but on the other hand the profits from some of the risky enterprises are often great. Therefore some of these crops seem justified, not as a source of certain returns, but as a possible source of comparatively large profits. The following information gives some insight into the possibilities of some of the enterprises that have been advocated for the region.

TRUCK CROPS.

Information was secured from 50 farmers concerning the success and failure of 7 of the leading truck crops raised.

Of 165 separate crops of cabbage produced on 50 farms, 69 made returns larger than the cost of production, while 96 crops brought little or no returns. The average yield of cabbage is 8 tons per acre. (See fig. 4.)

FIG. 4.—Cabbage is one of the leading truck crops produced. This is nearly a perfect stand, half grown.

Of 68 crops of lettuce produced on 25 farms, 45.5 per cent of the crops were successful. The average yield harvested during the season of 1914–15 was 221 hampers per acre. (See fig. 5.)

Onions were produced on 18 farms, and more than half (61.5 per cent) of the crops were successful. The average yield of onions is approximately 260 bushels per acre. This crop is best adapted to the lighter textured soils of the western part of the region.

Irish potatoes were raised on 24 farms, records being secured on 69 crops. Forty-three of these crops were profitable. Potatoes yield on the average less than 100 bushels per acre.

FIG. 5.—Lettuce is an important truck crop. This field has been cut over once. Two more cuttings will be made.

Snap beans and tomatoes were produced on 22 farms, 65 crops of beans and 58 crops of tomatoes being recorded. Fifty-one per cent of the bean crops brought profits, and 43 per cent of the tomato crops succeeded.

Only 10 farms produced cantaloupes, 20 crops being raised. Only 4 of these crops were profitable.

While the profits from the successful truck crops average greater than the losses from the failures, it appears that in general any one truck crop is successful only about half the time. Potatoes and onions appear to be somewhat more likely to succeed than others, while cantaloupes are seldom successful.

Other truck crops, such as spinach, table beets, kohlrabi, garlic, peppers, eggplant, okra, and turnips, are produced quite extensively and are successful to about the same extent as those crops above mentioned. It not infrequently happens that some one crop comes on the market at a time when the product is scarce, and under such conditions very large profits may be made. For some crops it is

possible to determine in advance the approximate conditions of the market at harvest time, and thus the time and amount of planting may be controlled, but this is not general.

SPECIAL CROPS.

Strawberries are produced in limited quantities. The successful crops have generally been marketed locally. A large increase in acreage is not encouraged.

Sugar beets have been advocated, but the beets grown thus far have not been sweet enough to justify the enterprise as a source of sugar production.

Grapes have been tried without success, failure being due to plant diseases and to lack of knowledge of methods. Some attention has been given to the cultivation of figs as a commercial proposition, but thus far this enterprise has not met with success.

Considerable attention has been given to the production of citrus fruits, and the production of oranges and grapefruit has been the basis of much advertising for the region. A very good quality of fruit is produced when the various difficulties of production are overcome, but no growers were found who had made a financial success of these enterprises. Among the difficulties encountered are loss of stock from freezing, disease, insect injuries, and lack of knowledge of methods of handling an enterprise of such delicate and varied requirements.

Sugar cane is produced principally on the large farms or plantations. On account of the fact that this crop requires equipment of large size and a great amount of power, it is not adapted to the average farm of the region.

Recently castor beans have been attempted on a commercial basis, but these have not been grown a sufficient length of time to determine their success.

STAPLE CROPS.

Corn is the leading staple crop raised in the region; the average yield is 42 bushels per acre. The average cost of producing corn for the market under conditions prevalent at the time of this study was 78 cents per bushel, while the market value was 67 cents. When corn is produced as a side line on truck farms the cost is less than 30 cents per bushel. It is more profitable to feed corn to stock than to dispose of it on the market. The crop is not raised profitably as the main source of income of the farm, but when produced to balance up the farm organization it is very profitable.

Alfalfa is produced successfully on well-drained land where little or no alkali is found. The average yield under present conditions is slightly over 4 tons per acre, or about 1 ton per cutting, produced at a cost of $8.60 per ton. The market value is approximately $13.50 per ton. As in other regions, good drainage is an absolute essential to the successful production of alfalfa here.

FIG. 6.—Sorghum for hay is of considerable importance. This field yielded nearly five tons of cured hay per acre.

Sorghum (see fig. 6) is the principal hay crop. Practically every farm produces a small acreage for home consumption. The average yield is nearly 5 tons of cured hay per acre; the cost of production is $8 per ton.

Stock beets are meeting a considerable demand for winter and spring stock feed (see fig. 7). These are particularly adapted to hog consumption. This feed averages 28 tons per acre at a cost of slightly less than $2 per ton.

Oats (Texas red-rust proof) (see fig. 8) are raised for pasture only; the crop seldom matures grain in this climate. These are planted in the early fall and are pastured from six to eight weeks later. With proper irrigation oats are pastured during three or four intervals through the winter, sometimes lasting into the summer. Not infrequently they are cut and fed as a soiling crop.

Among other feed crops that appear successful are Sudan grass and Rhodes grass, both of which may be utilized for either hay or pasture.

Cowpeas have received little attention up to the present, but a number of truck farmers find them very profitable as a green-manure crop to be plowed under. In a few cases the crop has been utilized as hay, very satisfactory yields being made.

Cotton has been produced in the region for many years both under irrigation and by dry-farming methods. Since the advent of the boll weevil the crop has not been generally successful, although occasional crops show very satisfactory yields. A yield of more than a bale per acre is common when the boll weevil does not attack the crop.

Attempts have been made at production of many other truck, staple, and special crops with indifferent success. A sufficient num-

ber have been mentioned above to show to some extent the possibilities and trend of production of the region.

STOCK PRODUCTION.

Hogs.—On account of the unstable conditions affecting the production and marketing of special crops considerable attention has been given to the production of stock; the principal lines followed are hog raising and dairying. Very satisfactory yields of feed crops have been a factor in advancing these enterprises. Of the breeds of hogs the Duroc Jersey is the most common; Poland China and Berkshires, however, are receiving some attention, while Tamworths and Hampshires are found in limited numbers. While the profits from hog raising under normal conditions are not so large as the fancy returns from some of the truck crops, the stability of the enterprise is such as to attract many to this type of farming. (See fig. 8.)

Very little cholera has appeared up to the present time, but there are a number of minor factors that are of importance, among these being the absolute necessity for shade protection in summer, and for a supply of pure water for the hogs, and the danger of infection of the stock by lice, mange, screw worms and other pests. That shade and a satisfactory supply of pure water are absolute essentials to successful hog production in the region has been fully demonstrated. Very satisfactory shade can be provided at very low cost by means of posts and cross poles covered with reeds or corn stalks or old sorghum hay. (See fig. 9.)

Concrete wallows filled with pure water offer perhaps the most satisfactory method of supplying the stock with water. Earthen wallows are used extensively, but there is difficulty in keeping them

FIG. 7.—Stock beets. This crop is receiving considerable attention as a feed crop for hogs.

FIG. 8.—Hogs are profitably pastured on winter oats.

clean: further, the sticky mud often adheres to the bellies of the hogs, sometimes causing sores, particularly in the case of sows with suckling pigs. Watering troughs are used, but there is danger of the supply failing at a critical time; further, it appears advisable for the animals to get into the water.

During warm weather various pests, such as lice and mange, attack the hogs. A very simple remedy for prevention and cure is the use of crude oil as a disinfectant. This may be applied directly from a sprayer or by pouring on the backs of the animals, or it may be placed in a rubbing post. It is not uncommon to place the crude oil on the surface of the water in the wallows. When the pests become well established before being discovered, an emulsion of coal oil and soap solution is commonly used as a spray.

Small scratches and the eyes and noses of pigs often become infected during the summer and if these infections are not cleansed they frequently cause considerable losses. Screw worms develop and bury deeply into the flesh. The use of crude oil as above indicated goes far toward preventing infection, but when screw worms have developed they must be removed or killed by the use of chloroform or the like.

Very few buildings are necessary for successful hog production; a shade for summer, a slight protection from cold rains during "northers" in winter, and farrowing pens for sows and pigs, fully answer the requirements.

Dairying.—This enterprise is receiving considerable attention, whole milk and cream being sold. The number of farms that can profitably sell whole milk is limited by the population of the towns supplied, so that this method of disposing of the dairy products can not be extended far beyond the present. There are a few very

profitable whole-milk dairy farms in operation, generally close to the towns.

Several creameries are in operation in the region and the farms supplying the cream are generally fairly profitable. At the present time large quantities of dairy products are brought into the lower Rio Grande Valley from northern sources, so that there should be a place for further development of this type of farming. Farms selling cream do not appear quite so profitable as those selling whole milk.

STABILITY OF TYPES OF FARMING.

From the foregoing discussion it appears that certain enterprises, such as the production of truck crops, are decidedly risky in this area. When the farms are properly organized, however, the total risk is reduced, since the success or failure of any one enterprise is not dependent upon or associated with another enterprise so far as market conditions are concerned.

Stock farms and staple crop farms are more stable, but not generally so profitable as farms producing considerable truck properly diversified. It appears that where the farm is so operated as to have from 40 to 50 per cent of the crop acres (including double-cropped land) in truck crops, better returns are made than when less truck is raised. On these farms about 40 per cent of the crop area is double-cropped and from 60 to 75 per cent of the total farm receipts are from the sale of truck products. Practically the whole farm produces staple crops during the summer and about one-half of it is in truck during the winter.

Hog raising in connection with truck production appears profitable and justified. A very large amount of otherwise waste material is

FIG. 9.—A cheap and satisfactory shade can be provided for the protection of hogs in summer by means of posts, cross poles, and hay or straw.

utilized on the successful truck-hog farm. Truck production does not appear to be generally successful where any considerable dairy business is conducted, although there are not sufficient data to make this conclusion definite.

FARM BUSINESS ILLUSTRATED.

For the purpose of showing the methods followed by farmers of some experience in the region, the actual operation of farms of three types is described, with some detail as to the character and extent of crops, receipts, expenses, and profits.

A TRUCK FARM.

The first farm is one on which truck production is the main enterprise. It is located in Hidalgo County and comprises 83 acres, of which 74 acres is crop land. On this 74 acres of crop land 100 acres of crops were harvested, 26 acres being double cropped, from March 1, 1914, to March 1, 1915. This farm represents an investment of $16,600 in real estate, or $200 per acre. Of the real estate valuation, $1,100 covers buildings. The stock on the farm was valued at $913 at the beginning of the year and consisted of 6 work animals, worth $450; 1 cow and 1 heifer, worth $145; hogs, worth $280; and poultry valued at $38.

For the operation of the farm there were machinery and tools to the value of $150, consisting of wagon, buggy, plows, cultivators, harrows, hoes, spades, etc. This equipment was estimated by the operator to have an average working life of about eight years. The amount of cash required to be kept on hand for current expenses was $800. Various crops were produced, the yields and sales from which are shown as follows:

Truck farm: Yields and sales of crops.

Crop.	Acres.	Unit of yield.	Yield.	Sales.
Corn	50	Bushel	2,500	$630
Sorghum	3½	Ton	20	(a)
Cowpeas	8			(b)
Grass pasture	2			
Snap beans	8	Bushel	600	900
Cabbage	9	Ton	36	410
Onions	8	Bushel	2,500	1,192
Green peas	4	do	30	30
Lettuce	1	Hamper	350	128
Potatoes	1¼	Bushel	125	215
Miscellaneous, nursery, etc	5			280
Total crop	99¾			3,785
Hog sales				352
Miscellaneous				71
Total receipts				4,208

a Feed. b Plowed under.

The principal items of expense were as follows: Labor, $1,445; seed, $163; crates, hampers, etc., $433; irrigation water, $451; taxes, $55. The depreciation of the buildings and machinery for the year was estimated by the operator to be $90. The total expenses of all kinds for the year's business to the operator, except the value of his own labor, amounts to $2,671.

As has been shown, the total receipts from all sources amounted to $4,208. When the expenses are deducted from the receipts the farm income is $1,537. The operator valued his own labor at $600 per year, which is deducted from the farm income. This shows a net income of $937, which is 5 per cent on the total investment of $18,513.

The degree of double cropping could be increased with profit on this farm. Only 35 per cent of the crop land produced a second crop during the year, and 8 acres of this land was in cowpeas. Crops that might increase profits by increased acreage are lettuce and potatoes.

An increase in the hog business doubtless would be profitable, providing slightly better management of the enterprise were provided. The farm supports seven brood sows producing two litters each per year. With this increase in hogs would follow the production of some other crops as hog feed, such as stock beets and oats for pasture. Greater profits would be made if the $630 worth of corn sold had been fed to hogs for the market.

The increase in acreage above suggested would not require the addition of further equipment. The acreage of crops per work animal was less than 17 at the time of this study.

A HOG FARM.

The following data show the business of a fairly successful hog farm located near the Rio Grande in Cameron County.

The farm consists of 71 acres, of which 59 acres is crop land, 7 acres permanent Bermuda grass pasture and 5 acres waste land. The real estate investment amounts to $14,200, of which the dwelling represents $800, barn, $200, and other buildings, $50. At the beginning of the year's business (1914–15) there was stock on the farm valued at $1,160, distributed as follows: Two cows and 2 calves, $80; 6 head of work stock, $527; 15 brood sows and boar, $250; poultry, $38; and 53 stands of bees, $265. Machinery and tools were valued at $734. Feed on hand at the beginning of the year was valued at $260, and the cash on hand for running expenses, $600. The total investment was therefore $16,954.

Few crops were raised, the principal crop being corn. Acreage and yield of crops were as follows:

Hog farm: Acreage and yield of crops.

Crop.	Acres.	Unit of yield.	Total yield.
Corn	47	Bushels	[a] 850
Oats pasture	3		
Milo maize	3	Tons	12
Alfalfa	1		
Sorghum	2	Tons (green)	50
Stock beets	2	Tons	90
Miscellaneous	1		

[a] 30 acres of corn was drowned out by river overflow, so that this yield was actually made on 17 acres.

No sales of crop products were made, all crops raised being fed on the place. This farmer followed the practice of slaughtering all hogs raised and selling the product as dressed meat. He was able to make a fair profit on the labor of slaughtering.

The amount of actual hog sales for the year was $1,256. The value of the stock increase on the farm for the year, exclusive of sales, amounted to $1,544. Total receipts from all sources were $2,830.

The principal items of expense were as follows: Labor, $417; machinery repairs, $137; feed bought (principally corn), $339; and irrigation water, $196. Depreciation of buildings and equipment was estimated to be $212. The total expense of farm operation, exclusive of the value of the operator's own labor, was $1,538.

The farm income is $1,292; when the value of the operator's labor ($450) is deducted, the net farm income is $842, or 5 per cent on the investment of nearly $17,000.

The horse-labor efficiency on this farm is low, only 10 acres being operated per animal. An automobile is used extensively for light hauling. No double cropping is practiced. All the receipts are from one source, namely, hogs. More machinery and tools are kept on this farm than are efficiently utilized, which accounts for a high repair bill in the expenses.

This farm could be made highly successful by diversification. The present acreage of corn is apparently about right to supply the farm needs when no accident such as overflow of the river interferes. Four or five different truck crops should be added to the organization. Doubtless more green forage for the hogs would be profitable. These increases in acreage of crops would increase the efficiency of equipment. From 15 to 20 acres of other crops can be raised under this organization and the principal added cost be only that for hired labor and irrigation water. The hog business should remain at about its present magnitude.

STAPLE CROP FARM.

Near the center of the irrigated district is a staple crop farm which produces some truck and a few hogs as side lines. This farm is perhaps better managed than the average, but an analysis of the business shows where certain improvements in organization can be made.

The farm comprises 100 acres, of which 95 acres is crop land, on which were produced during the year 113 acres of crops. The real estate investment amounts to $20,000, of which the house represents $500; barn, $100; and other buildings, $100. At the beginning of the year of this study the farm was stocked as follows: Six head of work stock, worth $680; 1 cow, $75; 6 brood sows and 36 other hogs, $390; and poultry, $38. The machinery and tools considered necessary for the cultivation of this irrigated farm were valued at $258. The cash on hand required to run the business amounted to $500. Feed on hand at the beginning of the year was worth $30. The total investment of the farm was therefore $21,971.

A considerable variety of crops was produced, the acreage, yield, and sales of each being as follows:

Staple crop farm: Acreage, yields, and sales of crops.

Crop.	Acres.	Unit of yield.	Total yield harvested.	Sales.
Corn	80.0	Bushel	4,550	$1,407
Sudan grass	4.5	Ton	24	
Cowpeas	1.5		(a)	
Rhodes grass	1.0		(b)	
Stock beets	1.0	Ton	30	
Sorghum	.5	do	2	
Alfalfa	5.0	do	5	
Cabbage	10.0	do	48	725
Lettuce	7.0	Hamper	850	425
Miscellaneous	2.5			
Stock sales				614
Receipts for outside work				255
Total	113.0			3,426

a Plowed under. b New.

The principal items of expense for the year's business were: Hired labor, $800; feed bought, $100; seed, $70; crates, hampers, etc., $106; and irrigation water, $320. The total expenses for the year, including depreciation, were $1,573.

When expenses are deducted from receipts the farm income is seen to be $1,853. The operator valued his own labor at $720. When this is deducted from the farm income there is left a net farm income of $1,133. This represents a return of 5 per cent on the farm investment of approximately $22,000.

This farm produced second crops on 19 per cent of its crop land. Each work animal covered the equivalent of 19 acres of crops. Slightly more than 41 per cent of the receipts were from the sale of

corn. The returns from the truck crop, cabbage, were low, the small yield indicated being all that was harvested. There was little market demand for cabbage so the remainder of the crop, about 8 tons per acre, was not cut. The same is true of lettuce, the average price received for the amount harvested being 50 cents per hamper, which is approximately the cost of production.

The acreage of second crops could be increased on this farm without increasing the amount of working capital. These second crops would be principally truck, other than cabbage and lettuce. Practically the only added expenses would be for hired labor and cost of irrigation water. The overhead expenses for the farm would remain practically the same. Increasing acreage of crops without added work stock would increase the efficiency of the animals and reduce the proportionate cost of horse labor to the various crops.

Since in general not all of the truck crops fail at the same time, crops other than cabbage and lettuce doubtless would have brought good returns, so that the truck business of the farm would have been profitable instead of only returning cost of production, as in this case.

Other crops for hog feed should be included in the organization and the magnitude of the hog business increased. The corn sold would doubtless have been more profitable if fed to hogs.

GENERAL CONDITIONS.

Conditions of irrigation and the varied character of the soils are factors which are new to nearly all who come to the region from other parts of the United States. Drainage, either natural or artificial, is necessary under all irrigation projects.

SOILS.

The soils of the irrigated district are varied in character, both with respect to differences in types and to differences in groups of types or series. Soils of the upland which are residual in character are of loam or sandy loam, and are located approximately to the north of the railroad in Hidalgo County. The soils of southern Hidalgo and Cameron Counties are derived from the delta formation (river deposits), and vary in texture from heavy black clay to medium-textured silt loams. These soils are affected somewhat by the temporary overflows of the present time. A silty soil known locally as "chocolate loam" is found along many of the resacas; this type is one of the best of the region on account of its ease of cultivation and better drainage conditions. The upland soils, on account of their lighter texture, have some underdrainage, which improves this condition materially in the western part of the region.

Practically all of the well-drained soils contain considerable percentages of lime, so important in the production of alfalfa. All soils of the region are exceptionally fertile and very productive when proper drainage and irrigation conditions are provided.

ALKALI.

Some of the low-lying soils contain alkali and, as is the case with all irrigated regions in dry climates, the use of irrigation water intensifies this condition. This is more particularly true near the larger canals, where seepage water permeates the bordering land. The use of drainage ditches and particularly opened "borrow pits" helps materially to improve this condition.[1] Tile drainage is sometimes resorted to where proper outlets are available. Thorough drainage will overcome these seeped and alkaline soil conditions.

CLIMATE.

The climate of the region is mild and healthful. The winters are sufficiently warm for the production of the principal truck crops. While the summers are comparatively long, they are not excessively hot, temperature seldom being higher than 98° F. There are short periods of disagreeable weather conditions in winter known as "northers," which are the southern phase of blizzards of the northwest and are accompanied generally by considerable wind and rain. The temperature often falls to the freezing point during these periods.

The average date of the first killing frost in the fall is December 21 and of the last in the spring February 6. The earliest frost date on record is November 15, and the latest in spring is March 5. It is not uncommon for a winter to pass without a single frost.

The average annual rainfall is approximately 27 inches, with the greatest monthly rainfall occurring during June and September. On account of the fact that many of the rains are torrential in character, the total precipitation is not so beneficial as is the case with slower and well-distributed rainfall. Not infrequently the annual rainfall reaches a maximum of 40 inches, while it may be as low as 12 inches per year.

There are occasional seasons when the rainfall is so well distributed and in such quantity as to make irrigation unnecessary. Indeed, in the vicinity of Lyford and Raymondville all crops are produced under dry-farming conditions, though the strictest methods of moisture conservation are necessary for successful farming.

The region is generally healthful, the subtropical diseases being very rare or nonexistent. Mosquitoes, fleas, and other insects are not serious pests to the inhabitants. On account of the mild climate there are a number of insect pests and plant diseases that attack crops to some extent.

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[1] A "borrow pit" is an excavation or ditch bordering a canal from which earth has been taken to form the banks of a canal. The pits are often irregular in size and depth, but when opened from one to another successively, drainage of seepage water from the canal may be effected.

FIG. 10.—The Rio Grande. This is the source of water for irrigation purposes.

IRRIGATION.

As above stated, crops are sometimes produced without irrigation, but during most seasons irrigation is essential to the best production.

All water for irrigation purposes is taken from the Rio Grande (see fig. 10), which borders the district on the south. Private capital has developed 20 or more separate systems for supplying water to farmers. Companies are incorporated under Texas laws, and when land is bought by the farmer contracts must be made with the companies to supply the necessary irrigation water.

The cost of water to the farmers varies considerably under different companies. Under some systems water is contracted for by the year at a stipulated price per acre. In such cases the farmer may produce as many crops and make as many irrigations as he desires. In other cases a flat rate of $3 or $4 per acre per annum is charged by the company, and then each acre irrigation costs $1 above this flat rate. This method is becoming common. In still other cases water is furnished at a stipulated price per crop.

The land companies and irrigation companies are generally separate organizations, although the same men are not infrequently directors in each.

On account of the many difficulties encountered in the development of irrigation systems, as well as in securing land buyers rapidly enough to place most of the land under irrigation quickly, some of the companies have had considerable financial difficulties. Under these conditions it is common for the farmers under the system to organize irrigation districts under the laws of Texas, issue and sell bonds, and purchase the irrigation systems. The land is the security

for these bonds. Under this method the landowners become the owners of the irrigation systems and operate them through their own representatives.

There are many instances where for various reasons water has not been furnished. This has caused considerable loss to the farmers and accounts to some extent for the withdrawal of many farmers from the region. Many of those who have moved away have lost considerable portions of their original investments.

While the prices paid by the districts for the irrigation systems are frequently high, the operation of the plants by the farmers themselves will doubtless insure water to the farmers with much greater certainty than has been customary in the past.

LAND TITLES AND PRICES.

Title to the land of the region was in general originally derived from the Spanish and Mexican Governments. Grants of many thousands of acres with a frontage on the Rio Grande were ceded to individuals before Texas became a part of the United States, and title to much of this land has never existed in the name of the State of Texas or of the United States. In opening for settlement, options were secured on the land and sometimes titles from the descendants of the original grantees. Land companies were organized for the purpose of reselling the land to actual farmers. A complete chain of title to this land is usually furnished by the companies for the purpose of examination by intending purchasers. It is possible to have these titles guaranteed by companies authorized to act under the laws of Texas. As soon as the irrigation companies had installed the pumping plants and provided sufficient canals so that even small quantities of water could be supplied, the land was placed on the market. By means of advertising in many other parts of the United States farmers and others are induced to come to the region to buy land.

Prices vary considerably under different companies, ranging from about $100 to $300 per acre for raw land. These prices pay for the water contracts as above described. Individuals outside of the companies hold land at from $40 to $75 per acre, but these lands do not always carry contracts for delivery of water by the irrigation companies.

Land may be rented either on the share basis or for cash at very reasonable rates, considering the price of land. Many farms have been operated by cash tenants for the consideration of from $3 to $10 per acre. The average cash rent for land, as estimated by 59 farmers of the area, is approximately $7 per acre.

LABOR.

The laborers of the section are almost altogether Mexican. Scarcely any negroes are encountered (1915). This labor is employed by the day, by the week, or by contract. Ordinarily laborers are secured at from $0.75 to $1 per day without rations, and the rate is practically the same by the week. In some instances laborers and their families are provided with houses (jacals) on the farms, and the labor is utilized as needed. This practice tends to secure stability and also increases the efficiency of the labor.

Practice has established that the employment of Mexican labor by contract is the cheapest and generally the most efficient. For such work as clearing land, transplanting and harvesting truck crops, etc., contract labor is commonly utilized. This method is particularly satisfactory since men, women, and children of the Mexican families perform labor of this character.

Mexican labor is comparatively inefficient, owing partly to lack of intelligence and lack of knowledge of good methods. While the average cost of hired labor is about $0.80 per day the cost of supervision as shown by records from 59 farms is $0.75 per day, so that the actual cost to the farmer is approximately $1.50 per day. A large percentage of the Mexican laborers can not speak English.

TRANSPORTATION.

The lower Rio Grande Valley is provided with only one railroad to outside markets. The St. Louis, Brownsville & Mexico lines (part of the St. Louis & San Francisco system) connect Brownsville with Houston, a distance of 372 miles (see fig. 1). By means of the San Antonio & Aransas Pass lines connection is made at Sinton, Tex., for San Antonio.

The St. Louis, Brownsville & Mexico Railway operates a branch line from Harlingen west to Mercedes, Mission, San Fordyce, and other points. Since the shipment of perishable produce has reached a considerable magnitude some difficulty has been encountered in the past in securing cars for freight transportation.

A local line, the San Benito & Rio Grande, known as the "Spiderweb" (see fig. 1) operates northeast and southwest from San Benito. A branch line of the St. Louis, Brownsville & Mexico Railway connects San Juan with Edinburg, the county seat of Hidalgo County. Another line extends north from Mission to Monte Christo.

The Rio Grande Railway, one of the oldest railroads in Texas, connects Brownsville with Point Isobel and Brazos Santiago Pass. Before the construction of the St. Louis, Brownsville & Mexico Railway to Brownsville, this line furnished the principal means of transportation. Formerly small freight and passenger boats from Gulf seaports entered Laguna Madre through Brazo Santiago Pass to

Point Isobel. Very little if any commerce is now carried on between Point Isobel and other Gulf ports.

MARKETS.

Brownsville, with a population of over 10,000, is the largest city of the region, and is located on the Rio Grande. San Benito, Harlingen, La Feria, Mercedes, Donna, Edinburg, Pharr, McAllen, and Mission each have a population of less than 5,000 people. The local consumption of farm produce, therefore, is quite limited. Houston and San Antonio are the nearest of the larger markets. A large volume of the perishable produce is sent to middle western cities, such as Kansas City, St. Louis, Omaha, Chicago, and St. Paul. Occasionally shipments are made as far east as New York City. The most important market for live hogs is Fort Worth, although Houston receives considerable numbers.

CONCLUSIONS.

The information and conclusions contained in this bulletin apply to conditions as they existed prior to the European war, and should in no way be interpreted as pertaining to abnormalities brought about by this cause. The data here presented were gathered during 1914 and 1915.

For farmers who desire a mild, healthful climate, the lower Rio Grande Valley is very desirable. A considerable amount of capital is required to develop an irrigated farm and a reasonable knowledge of general farming is of primary importance. For successful business, on account of climatic conditions and possibilities of irrigation, intense cultivation and good managerial ability are essential. Supervision of the Mexican labor must be close for its most efficient use.

Good land can be secured at prices ranging from $50 to $250 per acre, or it may be rented for from $3 to $10 per acre. Drainage and alkali conditions should be investigated carefully before purchasing land.

It appears that farms of less than 40 acres are not so successful as those of larger size. In general, staple crop and stock farms are larger in acreage than truck farms, although the last-named type, being more intense, does a larger business, acre for acre, than do farms of the other types.

The double cropping is of prime importance. This increases the magnitude of the business with but little effect in capitalization, and materially increases the profits. When 50 per cent of the crop land is utilized for a second crop the net returns are greater than when a smaller acreage is double cropped.

The most successful farms are those which produce a considerable diversity of truck crops during the winter months, practically the whole farm being in staple crops during the summer. The growing of truck and feed crops, with hogs as a side line, makes one of the most satisfactory types of organization from the standpoint of stability and profits. It appears that it is more profitable to feed corn to stock than to sell it on the market, although when produced as a side line it is generally profitable.

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CARL L. ALSBERG, Chief

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THE EFFECT OF ALKALI TREATMENT ON COCOAS.

By Eugene Bloomberg, *formerly Assistant Chemist, Buffalo Food and Drug Inspection Station.*

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PURPOSE OF THE INVESTIGATION.

IN THE PROCESS of the manufacture of cocoa, the cocoa beans are roasted, the shells removed, the nibs crushed in a mill, and the resultant product placed in a press whereby a part of the cocoa butter is removed. The press cake is then ground and sifted to form the cocoa of commerce. By the removal of this portion of fat the color of the cocoa is made considerably lighter. For many years it has been the endeavor of manufacturers of cocoa to darken the color of the cocoa so that it would more closely resemble chocolate. This effect has been sought in various ways, but the most prevalent method is by the addition of alkalies or alkaline carbonates. Ammonium carbonate and magnesium carbonate have also been used with this end in view. In this article the term "alkali treatment" will be understood to include the treatment of cocoa not only with the alkalies or alkaline carbonates, but also with such salts as ammonium carbonate and magnesium carbonate. This process is quite generally known as the "Dutching" process, and the cocoas made therefrom as "Dutched" or "Dutch process" cocoas. The name is derived from the fact that this method of treating cocoa originated in Holland.

Attempts have been made at various times to develop this enhanced color by means other than the addition of chemicals. Treatment with steam, under pressure; wetting the cocoa and allowing

it to ferment and then stopping the fermentation by heat; or simply adding water to the cocoa and heating the product to drive off this added water, have all been employed. When alkalies are used, the cocoa beans are partly roasted, then cracked, and the shells removed. The nibs are then treated, either in the roaster or in a separate kettle, with the salt dissolved in water, or, in the case of magnesium carbonate, made into an emulsion with water. The roast is then finished, heat being applied gradually to drive off the water completely. Sometimes this procedure is varied by roasting the beans entirely and cracking and winnowing them, adding the chemical to the cracked nibs in a water-jacketed kettle and applying heat until the product is dry. Although the first occasion for the employment of any of these methods was undoubtedly an attempt to develop a darker color in cocoas, it was later claimed that the alkali treatment renders the cocoa more soluble in water. There is practically no doubt that any of these treatments produces a cocoa which forms a more perfect suspension in the cup and which does not separate as readily from the water solution as does an untreated cocoa. This is largely due to the fact that a portion of the starch is gelatinized by the action of the water in the treatment of the cocoa. It is also claimed that the alkali disintegrates some of the cell walls, and in this way enables the cocoa to stand up better in the cup.

This investigation was undertaken primarily with a view to ascertaining whether the alkali treatment does in fact render the cocoa more soluble, and what changes take place in the cocoa as a result of this treatment. Comparatively little work has been done on the subject of alkali-treated or "Dutched" cocoas, and practically none with the object of the investigation here reported.

Farnsteiner [1] has made an exhaustive study of the effect on the cocoa ash of the addition of varying amounts of potassium carbonate and magnesium carbonate to cocoa. His work was carried out by treating the raw cocoa bean, which had been shelled and ground as finely as possible, with a definite amount of these reagents, ashing the mixture, and determining the ash constants on this product. In addition to this, he has worked out formulas for the determination of the amount of alkali used. He also examined a large number of cocoas in the same way, and endeavored from his researches to determine the percentage and kind of alkali employed. Other references to treated cocoas may be found in "Cocoa and Chocolate." [2] Practically the only subjects treated of in this book are the ash constants and the method of manufacture of Dutch process cocoa.

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[1] Z. Nahr. Genussm. (1908) **16**: 625–645.

[2] Whymper. P. Blakiston's Son & Co. (1912): 103–110, 117, 231–238.

DESCRIPTION OF INVESTIGATIONAL SAMPLES.

Practically all samples analyzed in this investigation were obtained directly from the manufacturer, the kind and percentage of alkali employed being known in nearly every case. As far as possible, samples were obtained from the same manufacturer of both treated and untreated cocoas made from the same blend of beans, ascertaining where possible what beans were used in the blend. The samples taken represent the products of a large majority of the manufacturers of so-called "Dutch process" cocoa in this country, and also four of the most popular foreign brands. In addition to these, samples were taken of plain cocoas manufactured by those concerns which made no "Dutch process" cocoa, for the purpose of determining the constants of a plain cocoa which could by no means be contaminated with a "Dutched" cocoa. Moisture and fat determinations were made on each sample so that all other determinations could be calculated to a moisture and fat free basis and the results made comparable. Table 1 gives the number of each sample, the variety of bean, the kind and percentage of alkali, and the amount of moisture and fat. Moisture was determined by drying at the temperature of boiling water for four hours. The fat was determined by extracting the sample in a Knorr extractor with anhydrous ether for four hours.

TABLE 1.—*Description of samples.*

No.	Blend.	Kind and percentage of alkali.	Moisture.	Fat.
			Per cent.	*Per cent.*
1		Untreated	4.07	17.81
2	Same as 1	2.5 per cent potassium carbonate	2.34	18.98
3	Accra, Bahia, Guyaquil	Steam treated	4.31	18.45
4	Accra, Sanchez	3 per cent potassium carbonate	1.98	21.15
5	Guyaquil, Bahia	2.5 per cent potassium carbonate	2.47	23.56
6	do	0.32 per cent ammonium carbonate, 1.65 per cent potassium bicarbonate, 0.15 per cent sodium bicarbonate.	4.40	20.65
7	Sanchez, Guyaquil	2.84 per cent sodium bicarbonate	3.73	20.90
8	Guyaquil, Sanchez, La Guaira, Bahia.	2 per cent potassium bicarbonate, 1 per cent ammonium carbonate.	3.49	20.23
9	Trinidad, La Guaira, Bahia, San Thome.	0.66⅔ per cent potassium carbonate, 0.33⅓ per cent ammonium carbonate.	3.49	18.22
10	Bahia, Arriba, Trinidad, Porto Cabello, Maracaibo, Ceylon.	2 per cent potassium bicarbonate, 1 per cent ammonium carbonate.	3.94	19.20
11		2.5 per cent potassium carbonate	2.92	25.28
12		do	3.03	17.90
13		Untreated	3.78	16.62
14		Water treated	3.07	20.12
15	Same as 11	2.5 per cent potassium carbonate, 10 per cent water.	3.19	25.48
16	Same as 12	1.5 per cent potassium carbonate, 1.5 per cent sodium carbonate.	4.55	20.68
17		Sodium carbonate	2.74	22.37
18		do	2.60	21.18
19	Sanchez, Trinidad	Untreated	3.62	21.28
20	do	2.5 per cent sodium carbonate	2.50	21.25
21		2 per cent sodium carbonate	2.81	23.21
22		1 per cent potassium carbonate	1.95	20.68
23	Same as 22	Untreated	2.65	15.89
24		1 per cent potassium carbonate	1.80	18.84
25		Untreated	4.30	22.71
26	Same as 25	4 per cent ammonium carbonate	4.78	20.18
27		Fermentation process	3.83	28.35
28	Bahia	1 per cent potassium carbonate	4.38	17.42

TABLE 1.—*Description of samples*—Continued.

No.	Blend.	Kind and percentage of alkali.	Moisture.	Fat.
			Per cent.	*Per cent.*
29	Bahia	Untreated	5.00	17.96
30		do	3.30	21.59
31	Same as 30	2 per cent sodium carbonate	3.25	20.63
32		Untreated	4.56	12.37
33	Same as 32	3 per cent sodium bicarbonate	3.50	16.54
34	Imported cocoa, alkali treated		4.64	28.37
35	do		4.60	27.4
[1] 36		Untreated	3.75	24.44
37	Imported cocoa, alkali treated		5.13	25.10
38	do		3.96	24.42
[1] 39		Untreated	2.81	22.50
[1] 40		do	4.80	25.20
[1] 41		do	4.18	23.42
[1] 42	Arriba, Trinidad	do	2.05	23.52
[1] 43	Arriba, Bahia, Accra, Sanchez	do	2.00	23.22
44		do	3.61	15.52
45		do	3.90	26.01
46	Same as 44	1 per cent of a mixture of magnesium carbonate and potassium carbonate.	3.66	18.77
47		Untreated	4.62	18.60
48		do	4.73	21.83
49		1 per cent of a mixture of magnesium carbonate and potassium carbonate.	2.75	28.40
50		1.75 per cent magnesium carbonate	3.00	30.00
51		Untreated	4.78	25.94
52		2 per cent of a mixture of magnesium carbonate and potassium carbonate.	3.70	19.83
53		1.5 per cent of a mixture of magnesium and potassium carbonates.	6.12	28.63
54		Untreated	5.31	21.98
[1] 55		do	2.83	21.23
[1] 56		do	2.46	24.48
[1] 57		do	5.08	22.68
[1] 58		do	5.21	22.68

[1] Manufactured by concerns which make no "Dutch process" cocoa.

As the percentage of moisture in the alkali-treated cocoas varies from 1.80 to 6.12 per cent, and in the untreated cocoas from 2 to 5.31 per cent, it is evident that practically all the water which is added in the treatment is driven off.

The percentage of fat in the alkali-treated cocoas varies from 16.54 to 30 per cent; that in the untreated cocoas varies from 12.37 to 26.01 per cent. Judging from these results, it is possible to remove more fat from the untreated cocoa than from a treated one, inasmuch as there are three samples of the untreated cocoas which contain less fat than the minimum of the treated cocoas. In cases where the treated and untreated cocoas are made from the same blend of beans and in the same way, almost invariably the alkali-treated cocoa contains a higher percentage of fat.

ANALYSES OF UNTREATED AND TREATED COCOAS.

Determinations of total ash, water-soluble and water-insoluble ash, alkalinity of the soluble ash, alkalinity of the insoluble ash, and protein were made on each sample. The Gunning method was used for the determination of nitrogen. The other determinations were made in the ordinary way, using methyl orange as an indicator in the titration of the alkalinities. The results obtained are given in Table 2, which contains the analyses of the untreated cocoas, Table 3,

containing the analyses of the treated cocoas, and Table 4, showing the result of alkali treatment by listing the treated and untreated cocoas of the same blend together. All results are calculated to a moisture- and fat-free basis.

TABLE 2.—*Analyses of untreated cocoas.*

No.	Ash.			Alkalinity of ash (N/10 acid per gram of sample).			Protein (N×6.25).
	Total.	Water-soluble.	Water-insoluble.	Water-soluble.	Water-insoluble.	Total.	
	Per cent.	*Per cent.*	*Per cent.*	*Cc.*	*Cc.*	*Cc.*	*Per cent.*
19	7.94	2.81	5.13	3.05	5.05	8.10	30.32
23	8.57	3.54	5.03	2.70	5.50	8.20	29.84
25	7.54	2.73	4.81	2.40	5.15	7.55	33.31
32	7.16	2.99	4.17	2.55	4.80	7.35	33.48
36	7.05	2.79	4.26	2.25	5.00	7.25	33.20
39	7.50	2.81	4.69	2.30	4.95	7.25	31.33
40	8.30	2.74	5.56	2.35	5.60	7.95	33.43
41	8.16	2.75	5.41	1.95	5.65	7.60	33.84
42	7.28	1.59	5.69	2.50	5.15	7.65	32.03
43	7.17	2.74	4.43	2.25	5.25	7.50	33.63
44	6.94	2.66	4.28	1.90	4.70	6.60	30.02
45	7.63	2.37	5.26	2.35	5.35	7.70	32.74
47	7.32	2.02	5.30	1.80	4.70	6.50	26.78
48	6.99	2.33	4.66	2.10	4.90	7.00	31.58
51	6.94	2.15	4.79	2.00	5.25	7.25	31.61
54	7.80	2.20	5.60	2.00	5.15	7.15	29.79
55	7.95	2.46	5.49	2.45	5.05	7.50	31.68
56	7.56	2.46	5.10	2.45	5.15	7.60	33.54
57	7.56	2.08	5.48	2.20	5.60	7.80	31.49
58	8.97	2.48	6.49	2.35	5.15	7.50	31.55
Maximum	8.97	3.54	6.49	3.05	5.65	8.20	33.84
Minimum	6.94	1.59	4.17	1.80	4.70	6.50	26.78
Average	7.62	2.54	5.08	2.30	5.15	7.45	31.75
1	7.21	3.76	3.45	3.20	4.90	8.10	31.93
13	8.10	4.62	3.48	4.00	4.35	8.35	31.08
29	7.37	3.88	3.49	3.35	4.60	8.00	32.97
30	8.34	4.61	3.73	4.05	5.25	9.30	31.48
3	9.80	7.44	2.36	6.80	4.90	11.70	30.33
14	7.49	4.18	3.31	3.25	4.45	7.70	33.64
27	8.45	1.61	6.84	1.15	6.35	7.50	40.03

Samples 1, 13, 29, and 30 were supposed to have been untreated cocoas, but they were made in a factory which also makes treated cocoas. Judging from the analytical data, they were contaminated with a certain amount of alkali-treated cocoa during the process of manufacture, for which reason they are excluded from the averages. Sample 3 was supposed to have been made by the straight steam treatment in place of having any added alkali. Sample 14 was made by thoroughly soaking the nibs and reroasting. These samples, however, were made only on an experimental scale. Inasmuch as they were run through the regular cocoa machinery in which "Dutch process" cocoa had been made, they were undoubtedly contaminated, as were the other samples. Sample 27 was made by a fermentation process, wetting the nibs and allowing them to ferment for some time in a warm place before finishing the roast. It will be noticed that the indicated protein in this sample is exceptionally high. This would lead to the conclusion that a certain amount

of some ammonium salt was added to these nibs, either during the fermentation or in the water in which they were soaked.

TABLE 3.—*Analyses of alkali-treated cocoas.*

No.	Alkali.	Ash.			Alkalinity of ash (N/10 acid per gram of sample).			Protein (N x 6.25).
		Total.	Water-soluble.	Water-insoluble.	Water-soluble.	Water-insoluble.	Total.	
		Per ct.	*Per ct.*	*Per ct.*	*Cc.*	*Cc.*	*Cc.*	*Per ct.*
4	3 per cent potassium carbonate	11.45	6.52	4.93	7.90	4.20	12.10	32.72
2	2.5 per cent potassium carbonate	8.36	4.89	3.47	4.00	4.90	8.90	31.72
5	do	10.52	6.63	3.90	5.90	4.55	10.45	32.57
11	do	11.49	8.75	2.74	7.25	6.15	13.40	33.18
12	do	11.00	8.08	2.92	7.35	5.40	12.75	33.79
15	2.5 per cent potassium carbonate and 10 per cent water	11.07	8.87	2.20	7.75	4.80	12.55	32.20
28	1 per cent potassium carbonate	8.31	5.98	2.33	5.10	4.80	9.90	33.04
24	do	9.07	5.22	3.85	4.80	5.35	10.15	31.45
22	do	9.20	5.82	3.38	5.45	5.35	10.80	32.59
33	3 per cent sodium bicarbonate	8.76	6.54	2.22	6.65	5.05	11.70	32.87
7	2.84 per cent sodium bicarbonate	10.48	7.96	2.52	6.60	5.90	12.50	31.09
20	2.5 per cent sodium carbonate	11.45	8.17	3.28	11.15	5.25	16.40	29.57
21	2 per cent sodium carbonate	10.97	8.15	2.82	9.95	4.90	14.85	28.71
31	do	10.23	7.54	2.69	8.60	5.30	13.90	29.62
18	Sodium carbonate	11.39	6.99	4.40	7.70	5.30	13.00	30.45
17	do	9.60	7.32	2.28	8.20	5.15	13.35	32.17
26	4 per cent ammonium carbonate	7.66	2.87	4.79	2.25	5.10	7.35	36.18
50	1.75 per cent magnesium carbonate	8.91	2.43	6.48	2.40	6.20	8.60	30.69
8	2 per cent potassium bicarbonate and 1 per cent ammonium carbonate	9.50	6.97	2.53	6.25	5.40	11.65	31.29
10	do	8.59	5.75	2.84	4.25	5.50	9.75	31.63
16	1.5 per cent potassium carbonate and 1.5 per cent sodium carbonate	11.62	9.36	2.26	10.35	4.85	15.20	31.92
9	0.66 per cent potassium carbonate and 0.33 per cent ammonium carbonate	9.15	5.22	3.83	4.40	5.55	9.95	31.29
52	2 per cent (magnesium carbonate and potassium carbonate)	7.78	4.25	3.53	4.10	5.25	9.35	27.75
53	1.5 per cent (magnesium carbonate and potassium carbonate)	8.29	4.75	3.54	4.45	6.35	10.80	33.52
46	1 per cent (magnesium carbonate and potassium carbonate)	7.87	3.52	4.35	3.15	5.05	8.20	31.31
49	do	9.32	5.08	4.24	4.50	5.00	9.50	30.82
6	1.65 per cent potassium carbonate, 0.15 per cent sodium carbonate, and 0.32 per cent ammonium carbonate	10.69	7.79	2.90	6.90	4.20	11.10	30.97
	Maximum	11.62	9.36	6.48	11.15	6.35	16.40	36.18
	Minimum	7.66	2.43	2.20	2.25	4.20	7.35	27.75
	Average	9.73	6.35	3.38	5.46	5.21	10.67	31.88
34	Imported	10.10	7.94	2.16	7.40	5.35	12.75	33.00
35	do	13.30	9.95	3.35	7.50	3.25	12.75	33.82
37	do	11.42	8.27	3.15	7.10	3.50	10.60	31.35
38	do	11.94	9.80	2.14	9.00	3.00	12.00	30.84

Sample 2 was supposed to have been made by the addition of 2.5 per cent potassium carbonate. The results obtained, however, would seem to indicate the addition of a much smaller quantity than this, probably not more than 1 per cent. Samples 34, 35, 37, and 38 are imported samples, all of which have been treated with alkalis, the kinds and percentages of which are, however, unknown.

The total ash on the samples varies from 7.66 to 11.62 per cent, with an average of 9.73 per cent. The minimum ash is that of a cocoa treated with 4 per cent ammonium carbonate, which will, of course, volatilize in the heating which the product subsequently undergoes. With this exception the lowest ash is 7.78 per cent, being the

ash of a cocoa treated with 2 per cent of a mixture of magnesium and potassium carbonates. The maximum ash, 11.62 per cent, is that of a cocoa treated with 1.5 per cent potassium carbonate and 1.5 per cent sodium carbonate. As would be expected, the ash varies approximately with the amount of alkali added.

Water-soluble ash varies from 2.43 to 9.36 per cent, with an average of 6.35 per cent. The lowest soluble ash is that of a cocoa which is treated with magnesium carbonate, which, of course, is insoluble in water. Next to this is one with a soluble ash of 2.87 per cent, which has been treated with ammonium carbonate. There are several varying from 3.52 to 4.75 per cent, which have been treated with a mixture of magnesium and potassium carbonates. The lowest water-soluble ash of those which are treated with soluble nonvolatile alkalies is 4.89 per cent.

The water-insoluble ash varies from 2.20 to 6.48 per cent, with an average of 3.38 per cent. The lowest insoluble ash was obtained from a cocoa treated with 2.5 per cent potassium carbonate and 10 per cent water. The highest is that of a cocoa treated with 1.75 per cent magnesium carbonate, which is insoluble in water. Aside from this one, the maximum water-insoluble ash is 4.93 per cent.

The alkalinity of water-soluble ash varies from 2.25 to 11.15 cc of N/10 acid per gram. Naturally, those treated with ammonium and magnesium carbonates show the lowest soluble alkalinity. Excluding these, the minimum is 4 cc. As might be expected, the maximum alkalinity is shown in those cocoas which have been treated with sodium carbonate. The alkalinity of the insoluble ash shows no points for discussion. The total alkalinity follows about the same order as the soluble alkalinity and for approximately the same reasons.

The protein varies from 27.75 to 36.18 per cent. This latter figure is attained on sample 26, which was treated with 4 per cent ammonium carbonate. This would probably explain the high protein percentage on the theory that a portion of the ammonia was not volatilized. Excluding this sample, the maximum is 33.79 per cent.

Table 4 shows the effect on the ash constants of the cocoa of the addition of alkali, or the effects of various alkalies on the same blend. Each pair was made from the same blend of beans and treated as stated in Table 4.

The results obtained are those which are normally expected on a treated cocoa, namely, that the total water-soluble ash and the alkalinity of the water-soluble ash are greatly increased, while the water-insoluble ash is decreased. This proves to be the case in every sample except sample 26, which shows practically no change in the ash constants. It is quite evident that the treatment with ammonia has made no change in the ash of the cocoa. Further

tables, however, will show that treatment with ammonia can be recognized by other changes in the analytical data. Sample 46 gives higher figures in all ashes and in all alkalinities than sample 44, due to the fact that it has been treated with both magnesium carbonate and potassium carbonate, the potassium carbonate increasing the water-soluble ash and the water-soluble alkalinity, and the magnesium carbonate increasing the water-insoluble ash and the water-insoluble alkalinity.

TABLE 4.—*Comparison of treated and untreated cocoas.*

No.	Alkali.	Ash.			Alkalinity of ash (N/10 acid per gram of sample).			Protein (Nx 6.25).
		Total.	Water-soluble.	Water-insoluble.	Water-soluble.	Water-insoluble.	Total.	
		Per ct.	*Per ct.*	*Per ct.*	*Cc.*	*Cc.*	*Cc.*	*Per ct.*
2	2.5 per cent potassium carbonate	8.36	4.89	3.47	4.00	4.90	8.90	31.72
1	Untreated	7.21	3.76	3.45	3.20	4.90	8.10	31.93
15	2.5 per cent potassium carbonate, 10 per cent water	11.07	8.87	2.20	7.75	4.80	12.55	32.20
11	Without water	11.49	8.75	2.74	7.25	6.15	13.40	33.18
16	1.5 per cent potassium carbonate, 1.5 per cent sodium carbonate	11.62	9.36	2.26	10.35	4.85	15.20	31.92
12	2.5 per cent potassium carbonate	11.00	8.08	2.92	7.35	5.40	12.75	33.79
22	1 per cent potassium carbonate	9.20	5.82	3.38	5.45	5.35	10.80	32.59
23	Untreated	8.57	3.54	5.03	2.72	5.50	8.20	29.84
20	2.5 per cent sodium carbonate	11.45	8.17	3.28	11.15	5.25	16.40	29.57
19	Untreated	7.94	2.81	5.13	3.05	5.05	8.10	30.32
26	4 per cent ammonium carbonate	7.66	2.87	4.79	2.25	5.10	7.35	36.18
25	Untreated	7.54	2.73	4.81	2.40	5.15	7.55	33.31
28	1 per cent potassium carbonate	8.31	5.98	2.33	5.10	4.80	9.90	33.04
29	Untreated	7.37	3.88	3.49	3.35	4.60	8.00	32.97
31	2 per cent sodium carbonate	10.23	7.54	2.69	8.60	5.30	13.90	29.62
30	Untreated	8.34	4.61	3.73	4.05	5.25	9.30	31.48
33	3 per cent sodium bicarbonate	8.76	6.54	2.22	6.65	5.05	11.70	32.87
32	Untreated	7.16	2.99	4.17	2.55	4.80	7.35	33.48
46	1 per cent (magnesium carbonate and potassium carbonate)	7.87	3.52	4.35	3.15	5.05	8.20	31.31
44	Untreated	6.94	2.66	4.28	1.90	4.70	6.60	30.02

Comparison of Tables 2 and 3 shows that the maximum percentage of total ash in the alkali-treated cocoas is 2.65 above that in the untreated cocoas, and the average is 2.11 higher. A wider variation is shown in the water-soluble ash, where the maximum percentage in the alkali-treated is 5.82 higher than the maximum of the untreated cocoas, and the average is 3.81 higher. With the exception of one sample of the treated cocoa, which has had added to it 1.75 per cent magnesium carbonate, the maximum percentage of water-insoluble ash in the untreated cocoa is 1.56 higher than in the treated cocoa, and the average is 1.27 higher. The soluble

alkalinity shows a maximum for the treated cocoas of 8.10 cc above the maximum for the untreated cocoas, and an average of 3.16 cc higher. There is very little difference in the figures on the insoluble alkalinities, and this difference would be still slighter if it were not for those few samples which have been treated with magnesium carbonate and which show a higher water-insoluble alkalinity on that account.

WATER-SOLUBLE MATTER IN UNTREATED AND TREATED COCOAS.

In order to determine the effect of alkali treatment on the solubility of the cocoa, the total water-soluble matter was determined in both treated and untreated cocoas. This was done by rubbing up 10 grams of the cocoa with 250 cc of water, heating to boiling and boiling for a minute, then allowing to stand over night and filtering. Fifty cc of this filtrate, corresponding to 2 grams of the original cocoa, were evaporated to dryness and dried to constant weight. These solids were then ashed, and the total ash, water-soluble ash, water-insoluble ash, alkalinity of the soluble ash, and alkalinity of the insoluble ash determined on each sample. Nitrogen was determined on a 50 cc portion of the filtrate, and protein calculated from this determination. It was noted that on addition of acid to the water solution of the "Dutched" cocoas a flocculent precipitate was thrown down. Upon investigation this proved to be a nitrogenous substance. To determine the amount of this nitrogenous substance present, a measured portion of the water solution of the cocoa was made acid with 1 per cent of sulphuric acid. This was then filtered, and nitrogen was determined upon an aliquot of the filtrate, and the protein calculated therefrom. The difference between the protein as here determined and that of the total water-soluble protein was the nitrogenous substances precipitated by the sulphuric acid. The color value on a brewer's scale of the water solution was determined in a Lovibond tintometer, using a ¼-inch cell. In making the water solution the cocoa was weighed as it came, but the results were all calculated to a moisture- and fat-free basis. These results are listed in Tables 5, 6, and 7. Table 5 gives the results obtained on untreated cocoas, Table 6 those on cocoas treated with alkalies, and Table 7 the comparison of the same blend of beans treated in various ways.

The water-soluble matter in the untreated cocoas varies from 29.16 to 35.55 per cent, with an average of 31.58 per cent. In the alkali-treated cocoas it varies from 24.90 to 37.02 per cent, with an average of 32.16 per cent. The minimum was obtained on a sample which was treated with magnesium carbonate, the next lowest being 28.17 per cent. The maximum percentage of water-soluble material in the alkali-treated cocoas is higher than that in the untreated cocoas by 1.47, while the average is 0.58 higher. This increase in solu-

bility is largely accounted for, however, by the water-soluble alkalies which have been added to the treated cocoas. This fact is shown by the percentage of water-soluble material less the ash of the water-soluble material, in which determination the untreated cocoas vary from 23.54 to 30.11 per cent, with an average of 25.53 per cent, while the treated cocoas vary from 19.58 to 28.93 per cent, with an average of 24.66 per cent, the untreated cocoas having a maximum percentage 1.18 higher than the maximum of the treated cocoas, a minimum percentage 3.96, and an average percentage 0.87 higher. There are eight samples of the alkali-treated cocoas which are less than the minimum of the untreated cocoas.

TABLE 5.—*Water-soluble matter in untreated cocoas.*

No.	Water-soluble matter.			Ash of water-soluble matter.						Water-soluble protein (N x 6.25).		Color value 4 per cent solution (¼-inch cell, brewer's scale).
	Total.	Ash-free.	Ash- and protein-free.	Total.	Water-soluble.	Water-insoluble.	Alkalinity (N/10 acid per gram of cocoa.)			Total.	Insoluble in 1 per cent sulphuric acid.	
							Water-soluble.	Water-insoluble.	Total.			
	P. ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cc.*	*Cc.*	*Cc.*	*Per ct.*	*Per ct.*	*Degrees.*
19	33.14	26.79	14.43	6.35	3.54	2.81	2.95	4.65	7.60	12.25	0.00	30.6
23	32.33	24.77	15.26	7.56	3.89	3.67	2.80	4.70	7.50	9.51	0.00	39.3
25	32.55	26.18	15.16	6.37	3.55	2.82	2.35	4.45	6.80	11.03	0.00	31.5
32	32.68	26.93	16.60	5.75	4.02	1.73	3.50	3.35	6.85	10.33	0.00	31.3
36	30.98	24.89	12.37	6.09	3.16	2.93	1.60	4.95	6.55	12.55	0.00	39.0
39	31.89	25.77	13.64	6.12	3.01	3.11	2.00	4.55	6.55	12.13	0.00	32.1
40	31.43	25.66	14.40	5.75	2.06	3.71	2.45	5.05	7.50	11.26	0.00	20.0
41	29.79	23.70	13.67	6.09	2.94	3.15	2.50	4.80	7.30	10.03	0.00	22.1
42	30.15	25.19	14.25	6.96	3.53	3.43	2.50	4.70	7.20	10.94	0.00	21.5
43	29.62	23.54	12.90	6.08	2.83	3.25	2.35	4.75	7.10	10.64	0.00	29.2
44	30.54	24.12	14.11	6.42	3.55	2.87	2.30	4.50	6.80	10.01	0.00	27.2
45	31.25	24.77	13.16	6.48	3.27	3.21	2.50	5.15	7.65	11.61	0.00	20.0
47	29.16	23.68	12.74	5.48	2.87	2.61	2.45	4.15	6.66	10.94	0.00	23.4
48	31.02	25.20	14.29	5.82	2.59	3.24	2.40	4.75	7.15	10.91	0.00	27.2
51	30.04	24.55	13.05	5.49	2.23	3.26	2.15	4.70	6.85	11.50	0.00	31.8
54	32.17	26.54	14.23	5.63	3.04	2.59	2.60	3.95	6.55	12.31	0.00	23.4
55	35.55	30.11	18.94	5.44	3.78	1.66	2.75	3.85	6.60	10.17	0.00	23.7
56	33.07	27.49	17.43	5.58	3.28	2.30	3.10	4.10	7.20	10.06	0.00	24.6
57	33.60	27.77	16.63	5.83	3.81	2.02	2.75	3.70	6.45	11.14	0.00	23.5
58	33.16	25.64	13.63	6.52	3.55	2.97	2.75	4.65	7.40	12.01	0.00	27.7
Max.	35.55	30.11	18.94	7.56	4.02	3.71	3.50	5.15	7.65	12.55	0.00	39.3
Min.	29.16	23.54	12.37	5.44	2.06	1.66	1.60	3.35	6.45	9.51	0.00	20.0
Aver.	31.58	25.53	14.47	6.06	3.22	2.84	2.54	4.35	6.89	11.06	0.00	27.4
1	28.29	21.17	10.78	7.12	4.59	2.53	2.00	3.85	5.85	10.39	0.81	36.8
13	33.69	25.56	14.00	8.13	6.31	1.82	4.90	2.95	7.85	11.56	1.66	34.4
29	31.84	26.15	13.43	5.69	3.91	1.78	3.50	3.75	7.25	12.72	1.96	50.6
30	33.90	26.96	14.79	6.94	4.79	2.15	5.15	3.30	8.45	12.17	.....	29.2
3	28.26	20.88	8.70	7.38	6.08	1.30	5.80	2.40	8.20	12.18	5.03	63.4
14	32.55	25.13	13.15	7.42	5.25	2.17	4.05	3.30	7.35	11.98	1.40	28.6
27	23.21	18.20	9.94	5.01	3.83	1.18	2.50	2.05	4.55	8.26	.....	8.8

TABLE 6.—*Water-soluble matter in alkali-treated cocoas.*

No.	Water-soluble matter.			Ash of water-soluble matter.						Water-soluble protein (N x 6.25).		Color value 4 per cent solution (½-inch cell, brewer's scale).
	Total.	Ash-free.	Ash- and protein-free.	Total.	Water-soluble.	Water-insoluble.	Alkalinity (N/10 acid per gram of cocoa).			Total.	Insoluble in 1 per cent sulphuric acid.	
							Water-soluble.	Water-insoluble.	Total.			
	P. ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cc.*	*Cc.*	*Cc.*	*Per ct.*	*Per ct.*	*Degrees.*
4	28.17	19.58	6.66	8.59	7.17	1.42	6.00	2.50	8.50	12.92	5.12	67.4
2	29.59	22.61	10.36	6.98	4.79	2.19	4.45	3.40	7.85	12.25	3.25	53.4
5	29.12	21.05	10.15	8.07	6.07	2.00	6.50	3.20	9.70	10.90	3.50	48.6
11	31.10	22.17	10.83	8.93	7.88	1.05	6.90	2.40	9.30	11.34	2.30	59.9
12	31.27	23.67	12.31	8.60	7.63	.97	6.75	2.90	9.65	11.36	2.67	49.3
15	37.02	27.22	15.53	9.80	9.00	.80	8.00	2.10	10.10	11.29	.79	70.0
28	33.50	25.89	12.86	7.61	6.53	1.08	5.00	3.05	8.05	13.03	2.32	81.8
24	32.74	24.86	14.60	7.88	6.02	1.86	4.70	3.85	8.55	10.26	.38	61.7
22	32.65	24.06	13.80	8.59	6.83	1.76	5.35	3.75	9.10	10.26	.94	67.3
33	31.26	24.76	13.76	6.50	5.12	1.38	6.80	2.00	8.80	11.00	1.21	81.4
7	31.40	22.84	12.39	8.56	7.43	1.13	6.95	2.70	9.65	10.45	1.65	59.7
20	36.72	28.93	17.27	7.79	7.17	.62	10.25	2.10	12.35	11.66	3.15	98.4
21	33.72	24.62	13.62	9.10	8.38	.72	8.70	2.90	11.60	11.00	.73	85.2
31	34.35	26.80	14.39	7.55	6.37	1.18	10.30	2.25	12.55	12.41	3.55	76.2
18	34.48	27.11	15.73	7.37	6.53	.84	9.05	2.52	11.55	11.38	1.72	85.3
17	35.93	27.76	15.53	8.17	6.77	1.40	8.80	2.55	11.35	12.23	2.79	86.8
26	33.42	28.22	15.16	5.20	4.10	1.10	2.50	3.15	5.65	13.06	1.77	68.0
50	24.90	20.15	10.49	4.75	3.25	1.50	3.65	4.40	8.05	9.66	1.05	49.2
8	32.09	24.46	13.38	7.63	6.69	.94	5.85	3.15	9.00	11.08	1.63	47.2
10	34.38	26.57	14.13	7.81	6.51	1.30	4.25	3.70	7.95	12.44	1.48	29.3
16	36.00	25.26	12.26	10.74	8.77	1.97	10.45	2.40	12.85	13.00	3.54	93.6
9	33.94	26.60	14.59	7.34	5.83	1.51	5.10	3.65	8.75	12.01	1.37	25.5
52	30.54	26.05	14.61	4.49	3.56	.93	4.60	2.85	7.45	11.44	1.83	75.8
53	33.15	28.26	15.98	4.89	3.94	.95	5.00	2.60	7.60	12.28	1.22	69.0
46	28.82	23.80	12.30	5.02	3.79	1.23	3.95	3.45	7.40	11.50	2.19	45.4
49	29.68	23.10	13.95	6.58	5.05	1.53	4.50	3.45	8.05	9.15	.89	36.3
6	28.34	20.31	9.16	8.03	6.67	1.36	6.50	2.20	8.70	11.15	4.55	73.4
Max.	37.02	28.93	17.27	10.74	9.00	2.19	10.45	4.40	12.85	13.06	5.12	98.4
Min.	24.90	19.58	6.66	4.49	3.25	.62	2.50	2.00	5.65	9.15	.38	25.5
Avg.	32.16	24.66	13.16	7.50	6.22	1.38	6.33	2.93	9.26	11.50	2.13	64.7
34	39.22	32.38	18.86	6.84	6.42	.42	7.55	1.35	8.90	13.52	3.45	111.9
35	33.57	24.55	13.92	9.02	7.89	1.13	7.75	2.10	9.85	10.63	2.19	107.5
37	42.01	33.68	17.81	8.33	7.58	.75	7.15	2.45	9.60	15.87	4.83	114.7
38	38.79	30.93	15.78	7.86	7.43	.43	8.40	1.85	10.25	15.15	3.35	101.9

These figures show that treatment with alkali does not increase the solubility of the cocoa material, but rather diminishes this solubility. Inasmuch as it was to be expected that treatment with alkali would increase the solubility of the protein and this expectation is borne out by the results obtained, the decrease in solubility must be due to the fact that the presence of the alkali has an inhibitory action on the solution of some of the nonnitrogenous substances. This is plainly shown in the third column of Tables 5 and 6, where the total solids less the protein and ash are calculated. Here the untreated cocoas range from 12.37 to 18.94 per cent, with an average of 14.47 per cent, while the treated cocoas range from 6.66 to 17.27 per cent, with an average of 13.16 per cent, the maximum percentage for untreated cocoa being 1.67 higher than that for the treated cocoa, the minimum 5.71 higher, and the average 1.31 higher. Nine samples of alkali-treated cocoa have less than the minimum of the untreated cocoa.

As might be expected, the ash of the soluble matter varies about the same as the ash of the cocoa.

The water-soluble protein is slightly higher in the alkali-treated cocoas than in the untreated cocoas, the maximum percentage being 0.51 higher, and the average 0.44 higher. The percentage of water-soluble protein insoluble in 1 per cent sulphuric acid, however, seems to be an important determination. In every case where the cocoa had been treated, more or less nitrogenous matter was precipitated by the addition of 1 per cent of sulphuric acid to the water-solution of the cocoa. This nitrogenous matter, calculated as protein, ranged from 0.38 to 5.12 per cent. The total water-soluble protein was not increased by any such figure. This would tend to show either that the alkali treatment inhibited the solution of some of the nitrogenous substances which would normally be dissolved by the water, or that some substance was dissolved by the alkali, which on the addition of sulphuric acid had precipitated some of the protein which was normally water-soluble. The untreated cocoas showed no precipitate on the addition of 1 per cent of sulphuric acid, the only exceptions to this being samples 1, 13, and 29, which have already been set aside on the ground that they were more or less contaminated with alkali-treated cocoas, having been made in a factory which also makes alkali-treated cocoas and passed through the same machinery. In no case where the sample was made by a firm which makes no alkali-treated cocoa was there any precipitate.

As might have been expected, the alkali treatment greatly enhanced the color of the water solution. The color values of the untreated cocoas ranged from 20 to 39.3, with an average of 27.4, those of the treated cocoas from 25.5 to 98.4, with an average of 64.7. Only three of the alkali-treated cocoas showed a color value of less than 46.4, and 16 showed a color value of over 60. The maximum of the alkali-treated cocoas was 59.1 above the maximum for the untreated cocoas, and the average was 37.3 above the average for the untreated cocoas.

Samples 1 and 2, representing the same blend of cocoas, sample 1 being untreated and sample 2 treated with 2.5 per cent potassium carbonate, show the effect of treatment. The total water-soluble matter, the water-soluble matter less the ash, the water-soluble protein, and the color value are increased by the alkali treatment. The nonnitrogenous, nonash soluble solids, however, are found in large amount in the untreated cocoa. Samples 15 and 11 represent the same blend of beans and the same alkali, but, in addition to the alkali, sample 15 had added to it 10 per cent of water in the treatment. This water treatment largely increased the soluble matter and deepened the color. Sample 16 was made with 1.5 per cent potassium carbonate and 1.5 per cent sodium carbonate, while sample 12 was made with 2.5 per cent potassium carbonate. The mixed carbonates in-

creased the total water-soluble matter and the water-soluble matter minus the ash, but the nonnitrogenous, nonash soluble matter did not vary. Of course, the increase in total amount of alkali increased the ash constants throughout. The greatest difference shown by these two treatments is the large increase in the color value of the solution by the use of the mixed carbonates. As will be shown later, this large increase in color is due principally to the action of the sodium carbonate.

TABLE 7.—*Comparison of water-soluble matter in treated and untreated cocoas.*

No.	Water-soluble matter.			Ash of water-soluble matter.						Water-soluble protein (N x 6.25).		Color value 4 per cent solution (¼-inch cell, brewer's scale).
	Total.	Ash-free.	Ash- and protein-free.	Total.	Water-soluble.	Water-insoluble.	Alkalinity (N/10 acid per gram of cocoa). Water-soluble.	Water-insoluble.	Total.	Total.	Insoluble in 1 per cent sulphuric acid.	
	P. ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cc.*	*Cc.*	*Cc.*	*Per ct.*	*Per ct.*	*Degrees.*
2	29.59	22.61	10.36	6.98	4.79	2.19	4.45	3.40	7.85	12.25	3.25	53.4
1	28.29	21.17	10.78	7.12	4.59	2.53	2.00	3.85	5.85	10.39	.81	36.8
15	37.02	27.22	15.53	9.80	9.00	.80	8.00	2.10	10.10	11.29	.79	70.0
11	31.10	22.17	10.83	8.93	7.88	1.05	6.90	2.40	9.30	11.34	2.30	59.9
16	36.00	25.26	12.26	10.74	8.77	1.97	10.45	2.40	12.85	13.00	3.54	93.6
12	31.27	23.67	12.31	8.60	7.63	97	6.75	2.90	9.65	11.36	2.67	43.3
22	32.65	24.06	13.80	8.59	6.83	1.76	5.35	3.75	9.10	10.26	.94	67.3
23	32.33	24.77	15.26	7.56	3.89	3.67	2.80	4.70	7.50	9.51	.00	39.3
20	36.72	28.93	17.27	7.79	7.14	.62	10.25	2.10	12.35	11.66	3.15	98.4
19	33.14	26.79	14.43	6.35	3.54	2.81	2.95	4.65	7.60	12.25	.00	30.6
26	33.42	28.22	15.16	5.20	4.10	1.10	2.50	3.15	5.65	13.06	1.77	68.0
25	32.55	26.18	15.16	6.37	3.55	2.82	2.35	4.45	6.80	11.03	.00	31.5
28	33.50	25.89	12.86	7.61	6.53	1.08	5.00	3.04	8.05	13.03	2.32	81.8
29	31.84	26.15	13.43	5.69	3.91	1.78	3.50	3.75	7.25	12.72	1.96	50.6
31	34.35	26.80	14.39	7.55	6.37	1.18	10.30	2.25	12.55	12.41	3.55	76.2
30	33.90	26.96	14.79	6.94	4.79	2.15	5.15	3.30	8.45	12.17	.00	29.2
33	31.26	24.76	13.76	6.50	5.12	1.38	6.80	2.00	8.80	11.00	1.21	81.4
32	32.68	26.93	16.60	5.75	4.02	1.73	3.50	3.35	6.85	10.33	.00	31.3
46	28.82	23.80	12.30	5.02	3.79	1.23	3.95	3.45	7.40	11.50	2.19	46.4
44	30.54	24.12	14.11	6.42	3.55	2.87	2.30	4.50	6.80	10.01	.00	27.2

Sample 22 was treated with 1 per cent potassium carbonate and shows a slightly increased total soluble matter, but less ash-free soluble matter and protein- and ash-free soluble matter. The alkali treatment shows an increase in the color value and the expected increase in the ash constants. Sample 20, treated with 2.5 per cent sodium carbonate, shows an increase in the soluble solids throughout and in the color value. Sample 26, treated with 4 per cent ammonium carbonate, shows a slight increase in the amount of soluble matter and in the color value of the solution. Sample 28, treated with 1 per cent sodium carbonate, shows a larger percentage of total soluble solids, but a smaller percentage of ash-free and protein- and ash-free

soluble matter. The color value has also been increased. Sample 29, however, shows from the analysis that a certain percentage of alkali-treated cocoa is present with it, so that the variations are not as great as might be expected. Sample 31, treated with 2 per cent sodium carbonate, shows a comparatively small variation in the soluble matter, but a large difference in the color value. Sample 33, treated with 3 per cent sodium bicarbonate, shows a diminution of the soluble matter, but an increased color value. Sample 46, which has been treated with 1 per cent of a mixture of magnesium and potassium carbonates, shows less soluble matter than a like sample untreated, but shows some increase in the color value of the solution.

COMPOSITION OF THE WATER-SOLUBLE MATTER IN UNTREATED AND TREATED COCOAS.

Tables 5, 6, and 7 give the analyses of the water-soluble matter as calculated back to the original cocoa. It was deemed advisable to calculate the composition of the water-soluble solids of the cocoa. This calculation is given in Tables 8 and 9. Comparison of these tables shows that the alkali treatment makes a marked difference in the composition of the water-soluble matter. Naturally the water-soluble matter from the alkali-treated cocoas contains a higher percentage of ash (4.05 on the average), a higher percentage of soluble ash (9.10 on the average), and less insoluble ash (5.05 on the average). The alkalinities of the ash are also higher on the treated cocoas, and the percentage of the total calculated protein is higher by 1.04 on the average.

TABLE 8.—*Composition of the water-soluble matter of untreated cocoas.*

No.	Ash.			Alkalinity of ash (N/10 acid per gram of sample).			Protein.		Ash-free and protein-free solids.
	Total.	Water-soluble.	Water-insoluble.	Water-soluble.	Water-insoluble.	Total.	Total.	Precipitated by 1 per cent sulphuric acid.	
	P. cent.	*P. cent.*	*P. cent.*	*Cc.*	*Cc.*	*Cc.*	*P. cent.*	*P. cent.*	*P. cent.*
19	19.16	10.68	8.48	8.85	14.05	22.90	36.96	0.00	43.88
23	23.39	12.03	11.36	8.75	14.40	23.15	29.42	0.00	47.19
25	19.57	10.90	8.67	7.15	13.70	20.85	33.88	0.00	46.55
32	17.60	12.30	5.30	10.70	10.30	21.00	31.60	0.00	50.80
36	19.64	10.20	9.44	5.15	14.40	19.55	40.49	0.00	39.87
39	19.18	9.45	9.74	6.30	14.30	20.60	38.03	0.00	42.79
40	18.20	6.49	11.71	7.65	16.00	23.65	35.50	0.00	46.30
41	20.45	9.88	10.57	8.35	16.20	24.55	33.66	0.00	45.89
42	23.09	11.72	11.37	8.25	15.60	23.85	36.29	0.00	40.52
43	20.73	9.66	11.07	7.95	16.15	24.10	36.26	0.00	43.01
44	21.01	11.62	9.39	7.50	14.80	22.30	32.79	0.00	46.20
45	20.73	10.46	10.27	8.00	16.45	24.45	37.17	0.00	42.10
47	18.80	9.83	8.97	8.50	14.05	22.55	37.52	0.00	43.68
48	18.79	8.34	10.45	7.70	15.35	23.05	35.16	0.00	46.05
51	18.29	7.41	10.88	7.20	15.65	22.85	38.80	0.00	42.91
54	17.49	9.45	8.04	8.10	12.20	20.30	37.97	0.00	44.54
55	15.30	10.63	4.67	7.80	10.75	18.55	26.74	0.00	57.96
56	16.89	9.94	6.95	9.30	12.40	21.70	30.42	0.00	52.79

TABLE 8.—*Composition of the water-soluble matter of untreated cocoas*—Continued.

No.	Ash.			Alkalinity of ash (N/10 acid per gram of sample).			Protein.		Ash-free and protein-free solids.
	Total.	Water-soluble.	Water-insoluble.	Water-soluble.	Water-insoluble.	Total.	Total.	Precipitated by 1 per cent sulphuric acid.	
	P. cent.	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*	*P. cent.*
57	17.35	11.35	6.02	9.25	10.90	19.15	33.16	0.00	49.49
58	19.66	10.71	8.95	8.35	14.00	22.35	36.22	0.00	44.12
Maximum	23.39	12.30	11.71	10.70	16.45	24.55	40.49	0.00	57.96
Minimum	15.30	6.49	4.67	5.15	10.30	18.55	26.74	0.00	39.87
Average	19.27	10.16	9.11	8.01	14.08	22.09	34.91	0.00	45.83
1	25.16	16.22	8.94	7.10	13.60	20.70	36.72	2.86	38.12
13	24.13	18.73	5.40	14.55	8.75	23.30	34.31	4.92	41.56
29	17.86	12.27	5.59	11.00	11.80	22.80	39.95	6.15	42.19
30	20.46	14.14	6.32	15.10	9.80	24.90	35.90	0.00	43.60
3	26.11	21.51	4.60	20.50	8.50	29.00	43.10	17.80	30.79
14	22.80	16.20	6.60	12.40	10.20	22.60	36.80	4.28	40.40
27	21.60	16.52	5.08	10.80	8.90	19.70	35.58	0.00	42.82

TABLE 9.—*Composition of the water-soluble matter of alkali-treated cocoas.*

No.	Ash.			Alkalinity of ash (N/10 acid per gram of sample).			Protein.		Ash-free and protein-free solids.
	Total.	Water-soluble.	Water-insoluble.	Water-soluble.	Water-insoluble.	Total.	Total.	Precipitated by 1 per cent sulphuric acid.	
	P. cent.	*P. cent.*	*P. cent.*	*Cc.*	*Cc.*	*Cc.*	*P. cent.*	*P. cent.*	*P. cent.*
4	30.51	25.47	5.04	21.30	8.90	30.20	45.90	18.20	23.59
2	23.58	16.19	7.39	15.05	11.45	26.50	41.73	10.98	35.69
5	27.71	20.84	6.87	22.30	11.00	33.30	37.43	12.02	34.86
11	28.80	25.42	3.38	22.25	7.75	30.00	36.58	7.42	34.62
12	27.50	24.40	3.10	21.60	9.25	30.85	36.37	8.58	36.13
15	26.49	24.33	2.16	21.55	5.70	27.25	30.50	2.12	43.01
28	22.71	19.50	3.21	14.90	9.15	24.05	38.89	6.91	38.40
24	24.06	18.40	5.66	14.45	12.10	26.55	31.33	1.15	44.61
22	26.32	20.93	5.39	16.65	11.30	27.95	31.42	2.89	42.26
33	20.39	16.04	4.35	21.35	6.25	27.60	34.51	3.81	45.10
7	27.26	23.66	3.60	22.15	8.60	30.75	33.28	5.26	38.46
20	21.21	19.61	1.60	27.85	5.70	33.55	31.75	8.57	47.04
21	27.26	25.11	2.15	26.10	8.75	34.85	32.97	2.19	39.77
31	21.99	18.55	3.44	30.00	6.50	36.50	36.14	10.37	45.10
18	21.38	18.95	2.43	26.25	7.25	33.50	32.99	4.99	45.63
17	22.74	18.84	3.90	24.50	7.05	31.55	34.04	7.77	43.22
26	15.54	12.27	3.27	7.95	8.95	16.90	39.06	5.30	45.40
50	19.07	13.07	6.00	14.70	17.70	32.40	38.78	4.20	42.14
8	23.77	20.85	2.92	18.25	9.80	28.05	34.53	5.08	38.70
10	22.72	18.94	3.78	12.35	10.75	23.10	36.19	4.31	41.09
16	29.84	24.38	5.46	29.00	6.65	35.65	36.12	9.85	34.04
9	21.60	17.16	4.44	15.00	10.75	23.10	36.19	4.31	43.05
52	14.69	11.65	3.04	15.00	9.40	24.40	37.47	6.00	47.84
53	14.75	11.88	2.87	15.05	7.85	22.90	37.03	3.65	48.22
46	17.40	13.15	4.25	13.65	12.10	25.75	39.90	7.60	42.70
49	22.17	17.03	5.14	15.15	12.00	27.15	30.84	2.99	46.99
6	28.33	23.53	4.80	22.95	7.75	30.70	39.34	16.05	32.33
Maximum	30.51	25.47	7.39	30.00	17.70	36.50	45.90	18.20	48.22
Minimum	14.69	11.65	1.60	7.95	5.70	16.90	30.50	1.15	23.59
Average	23.32	19.26	4.06	19.53	9.27	28.80	35.95	6.74	40.64
34	17.43	16.36	1.07	19.20	3.40	22.60	34.47	8.82	48.10
35	26.88	23.51	3.37	23.00	6.35	29.35	31.66	6.53	41.46
37	19.82	18.05	1.77	17.05	5.80	22.85	37.77	11.50	42.41
38	20.23	19.11	1.12	21.55	4.85	26.40	38.98	8.66	40.79

As has been noted, the water-soluble matter of the alkali-treated cocoas has present a protein which is insoluble in 1 per cent sulphuric acid. This varies from 1.15 to 18.20 per cent of the solid matter. The greatest variation, however, is shown in the nonash, nonprotein matter, which varies from 39.87 to 57.96 per cent, with an average of 45.83 per cent, on the untreated cocoas, and from 23.59 to 48.22 per cent, with an average of 40.64 per cent, on the treated cocoas. Eleven samples of treated cocoas contain a smaller percentage of ash- and protein-free extract than the minimum of the untreated cocoa. This shows still more plainly what was shown in the analysis of the cocoas, namely, that the alkali treatment inhibits the solution of this nitrogen-free extract. On the other hand, the alkali treatment unquestionably increases, to a slight extent, the solubility of the protein.

ASH RATIOS IN UNTREATED AND TREATED COCOAS.

The ratio of the water-soluble ash to the water-insoluble ash was calculated on both the original cocoa and on the water-soluble matter; also, the ratio of the alkalinities of the soluble and insoluble ash was calculated on each of these. These results are listed in Tables 10 and 11.

TABLE 10.—*Ash ratios on untreated cocoas.*

No.	Water-soluble ash / Water-insoluble ash		Alkalinity water-soluble ash / Alkalinity water-insoluble ash		No.	Water-soluble ash / Water-insoluble ash		Alkalinity water-soluble ash / Alkalinity water-insoluble ash	
	Cocoa.	Water-soluble matter.	Cocoa.	Water-soluble matter.		Cocoa.	Water-soluble matter.	Cocoa.	Water-soluble matter.
19	0.55	1.26	0.61	0.63	55	0.45	2.28	0.48	0.72
23	.70	1.06	.49	.61	56	.49	1.43	.48	.75
25	.56	1.25	.47	.52	57	.38	1.88	.39	.75
32	.71	2.31	.52	1.04	58	.39	1.19	.46	.59
36	.65	1.81	.44	.36					
39	.60	.95	.46	.44	Maximum	.71	2.31	.61	1.04
40	.49	.55	.42	.48	Minimum	.28	.55	.34	.36
41	.51	.93	.34	.51	Average	.51	1.24	.41	.59
42	.28	1.03	.48	.53					
43	.62	.87	.44	.49	1	1.09	1.82	.65	.53
44	.62	1.24	.41	.51	13	1.33	3.46	.93	1.66
45	.45	1.02	.44	.49	29	1.11	1.46	.73	.93
47	.38	1.08	.39	.60	30	1.23	2.23	.77	1.54
48	.50	.80	.43	.50	3	3.16	4.70	1.38	2.43
51	.45	.68	.39	.46	14	1.26	2.45	.74	1.22
54	.39	1.18	.36	.67	27	.24	3.25	.19	1.21

Except on those samples which were treated with magnesium or ammonium carbonate, the soluble ash is invariably greater than the insoluble ash on the treated cocoas, the lowest figure (with the exceptions noted) being 0.81 and the average figure 1.88. With the exception of samples 1, 13, 29, and 30, which have been excluded from the general averages throughout on the ground of having been contaminated with more or less alkali-treated cocoa, the correspond-

ing ratio for the untreated cocoa has a maximum of 0.71, with an average of 0.51. This simply bears out the general belief that in a treated cocoa the soluble ash is approximately two-thirds of the total, while in an untreated cocoa it is one-third of the total.

TABLE 11.—*Ash ratios on alkali-treated cocoas.*

No.	Water-soluble ash / Water-insoluble ash		Alkalinity water-soluble ash / Alkalinity water-insoluble ash		No.	Water-soluble ash / Water-insoluble ash		Alkalinity water-soluble ash / Alkalinity water-insoluble ash	
	Cocoa.	Water-soluble matter.	Cocoa.	Water-soluble matter.		Cocoa.	Water-soluble matter.	Cocoa.	Water-soluble matter.
4	1.32	5.06	1.88	2.36	8	2.75	7.08	1.16	1.85
2	1.41	2.19	.82	1.32	10	2.03	5.00	.76	1.14
5	1.70	3.01	1.32	2.00	16	4.14	4.46	2.15	4.33
11	3.18	7.55	1.18	2.43	9	1.33	3.84	.79	1.40
12	2.72	7.83	1.35	2.33	52	1.20	3.83	.79	1.59
15	4.03	11.45	1.63	3.80	53	1.34	4.14	.69	1.91
28	2.57	6.08	1.07	1.62	46	.81	3.09	.63	1.13
24	1.36	3.25	.89	1.19	49	1.20	3.31	.90	1.27
22	1.68	3.88	1.01	1.47	6	2.70	4.90	1.62	2.88
33	2.95	3.68	1.31	3.41					
7	3.16	6.59	1.12	2.59	Maximum	4.14	12.20	2.19	4.87
20	2.49	12.20	2.12	4.87	Minimum	.37	2.18	.38	.83
21	2.88	11.60	2.19	3.00	Average	1.88	4.51	1.26	2.31
31	2.80	5.39	1.58	4.62					
18	1.59	8.78	1.44	3.63	34	3.67	15.36	1.37	5.61
17	3.20	4.83	1.60	2.47	35	2.98	6.96	2.93	3.62
26	.60	3.75	.45	.89	37	2.63	10.17	2.02	2.94
50	.37	2.18	.38	.83	38	4.58	17.16	3.00	4.44

Similar figures for the ash of the water-soluble matter show a wider variation, the ratio for the alkali-treated cocoa showing a minimum of 2.18 with an average of 4.51, while the ratio on the untreated cocoa has a maximum of 2.31, with an average of 1.24. Only one sample of the untreated cocoa is higher than the minimum of the treated cocoas.

The ratio between the alkalinity of the water-soluble ash and the alkalinity of the water-insoluble ash on the untreated cocoa varies from 0.34 to 0.61, with an average of 0.41. Only two samples have a ratio above 0.50. On the alkali-treated cocoas, however, the range is from 0.38 to 2.19, with an average of 1.26. Aside from sample 50, only one ran below 0.63. This sample had been treated with magnesium carbonate, which, of course, increased the alkalinity of the insoluble ash. In the same ratio of the water-soluble matter the untreated cocoas varied from 0.36 to 1.04, with an average of 0.59. Only one sample exceeded 0.75. The treated cocoas, on the other hand, varied from 0.83 to 4.87, with an average of 2.31, only three samples being less than 1.14. The ratios of the water-soluble and water-insoluble ash of the water-soluble matter and the ratios of the alkalinities of the water-soluble ash and the water-insoluble ash, on both the cocoa and the water-soluble matter, are fully as complete evidence of the use

of alkali treatment as is the commonly accepted ratio of the water-soluble to water-insoluble ash on the cocoa; in fact, in samples such as 26, which was treated with ammonium carbonate, and 50, which was treated with magnesium carbonate, the ratio of the water-soluble ash to the water-insoluble ash of the water-soluble matter and also the alkalinity ratio show the presence of an added alkali where the ordinary ratio does not.

ACTION OF VARIOUS ALKALIES ON COCOAS.

In Tables 3, 6, and 9, the alkali-treated cocoas are listed according to the alkali used and according to the percentage of that alkali, making it possible to note the action of the various alkalies in their various proportions. Results are not exactly comparable, because the same blend of beans was not used in each case, but, as showing the general effect of each of these alkalies, and as comparing the effects of the various alkalies, they are of great value. Samples 34, 35, 37, and 38 are, as has been mentioned, imported cocoas, and the alkali used is unknown. Also, as has been pointed out, sample 2, which was supposed to have been made with 2.5 per cent potassium carbonate, contains less than this amount, judging from the analysis, probably as little as 1 per cent. The only points worthy of note in this connection in Table 3 are: That the presence of sodium carbonate can be detected by the high alkalinities in practically every case; that ammonium carbonate exercises no effect on the normal cocoa ash, but that it is extremely difficult to remove all of the ammonia, as is shown by the fact that the indicated total protein on this sample is somewhat higher than normal; that the use of magnesium carbonate has the effect of increasing the water-insoluble ash and the alkalinity of the water-insoluble ash. In Table 6 the differences in the action of the alkali are more apparent. It will be noted that the treatment with 2.5 per cent potassium carbonate and 10 per cent of water gave the maximum total soluble matter, the use of the water evidently increasing the solubility of the cocoa. A curious point in this connection is the fact that as the percentage of potassium carbonate used increases, the soluble matter decreases, with the exception of the one mentioned where water was also used. Therefore, if the intention is to obtain a more soluble cocoa, the use of 1 per cent potassium carbonate rather than larger amounts is to be recommended. This difference is still more apparent when the soluble matter minus the ash is calculated. Sodium carbonate has a much greater solvent action than has the potassium carbonate. Slightly less protein is dissolved by sodium carbonate than by potassium carbonate, but the total soluble matter, ash-free soluble matter, and ash- and protein-free soluble matter are greater in those cocoas which have been treated with sodium carbonate. A mixture of the two, as shown in sample

16, combines to some extent the action of each, inasmuch as the total soluble matter is high and the soluble protein is high. The ash- and protein-free solids are, however, rather low, as compared with those in which sodium carbonate alone was used, thus seeming to indicate that potassium carbonate has an inhibitory action on the solution of these solids. Sample 50, in which magnesium carbonate was used, shows the lowest total water-soluble matter. This is partly due to the fact that no soluble alkali is added, as the ash-free solid matter is nearer to the average of the cocoas.

There seems to be no definite relation between the amounts of water-soluble protein insoluble in 1 per cent sulphuric acid and the alkali used. This figure varies somewhat with the percentage of alkali, although by no means in proportion. The color value of the solution also shows a very wide range, and seemingly follows no definite rule, except that the use of sodium carbonate gives the highest values.

It is interesting to note that three of the four imported cocoas show a total soluble matter and an ash-free soluble matter greater than the maximum of the domestic treated cocoa, and two of them show a greater ash- and protein-free soluble matter; also three show a higher percentage of soluble protein than the maximum of the domestic products, and all four show a higher color value than the maximum. With one exception, the total ash of these products is not appreciably greater than that of the domestic products, and the ash of the water-soluble matter falls well within the limits of the domestic products. This indicates that the increase in the other constituents is not the result of the addition of a larger amount of an alkali, such as sodium carbonate, but that the difference lies largely in the treatment which the cocoa undergoes.

APPEARANCE OF THE COCOAS.

The color of the dry cocoa in the samples examined varied widely, from a light brown to a deep reddish purple. Some of the untreated cocoas had a color nearly as pronounced as those that were treated. This color is not necessarily the result of any blend of beans, but depends largely on the treatment, especially the degree and rapidity of heating and cooling which the cocoa undergoes in its manufacture. The color of the dry cocoa seems to have but little connection with the color of the water solution. For instance, sample 27, a cocoa treated by a fermentation process, is among the darkest in the dry state, but the water solution of this is of a very light straw color, as may be noted by the fact that the color value of a 4 per cent solution in a $\frac{1}{4}$-inch cell was only 8.8. This is the most striking example of the fact that the color of the dry cocoa and that of the water solution bear little or no relation to each other. The same thing was noted,

to a lesser degree, in a great number of the other cocoas. In some cases a cocoa which seems to be of a quite light color when dry shows a very high color in the water solution. The color developed in the cocoa depends, of course, somewhat on the blend of beans used, but to a greater extent on the treatment which the product undergoes.

CONCLUSIONS.

The greatest effect of the alkali treatment of cocoas is apparently the increase in the color of the water solution. The total water-soluble matter is increased but slightly, and this increase is more than accounted for on the ground of the addition of the soluble alkali, the ash-free soluble matter being less in the case of an alkali-treated cocoa than in the case of the untreated cocoas. There is a slight increase in the amount of water-soluble protein by the alkali treatment. This, however, is more than made up for by the fact that the alkali treatment exercises an inhibitory action on the solution of the non-nitrogenous substances which are normally soluble in water. A portion of the water-soluble protein of the alkali-treated cocoas seems to be different from that dissolved in the untreated cocoas, inasmuch as it is rendered insoluble when the water solution is made 1 per cent acid with sulphuric acid. This is a point of difference between alkali-treated and untreated cocoas which might well serve for the detection of the alkali treatment.

As has been pointed out by other investigators, the alkali treatment increases the ratio of the soluble ash to the insoluble ash. This is true with all the alkalies employed, except ammonium carbonate and magnesium carbonate. Both of these, however, increase this ratio in the ash of the water-soluble matter, and this determination might serve as a clue to their presence. The ratio of the alkalinities of the ashes is still more pronounced than the ratio of the ash. The presence of an alkali-treated cocoa may therefore be proved by the high color value of the water solution, by the presence of a water-soluble protein precipitable in 1 per cent sulphuric acid, and by the increase in the ash ratios and the alkalinity ratios.

This investigation proves that the claim that the alkali treatment increases the amount of cocoa soluble in water is absolutely without foundation.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 667

Contribution from Bureau of Markets,
CHARLES J. BRAND, Chief.

Washington, D. C. ▼ June 8, 1918

CAR-LOT SHIPMENTS OF FRUITS AND VEGETABLES IN THE UNITED STATES IN 1916.

By Paul Froehlich, *Assistant in Market Surveys.*[1]

APPRECIATION.

To the local freight agents and other representatives of transportation lines whose reports have made possible the publication of this bulletin, the sincere appreciation of the Bureau of Markets is extended. This work is the combined product of the contributions of many thousands of individual reporters throughout the country, and acknowledgment is made of their cooperation.

Criticisms are invited of the statistics presented in this publication. An official post card, which requires no postage, is inclosed, and on this card constructive suggestions are desired by which the contents of similar volumes may be improved.

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EXPLANATORY STATEMENT.

One of the established features of the work of the Bureau of Markets is a system of mail reports of carload shipments of all kinds of fresh or dried fruits and vegetables. This was instituted in the spring of 1916, when the Bureau sent to about 25,000 agents of the various carriers which handle these commodities blanks for reporting each car-lot shipment. The agents were instructed to mail a card for each carload of fruits or vegetables billed from their respective stations. Most of the reports were in the form of postal cards of the design shown on the page following.

[1] The Transportation Section of the Bureau of Markets perfected the arrangements with the carriers for the system of daily mail reports which have made possible the compilation of this bulletin. The system has been developed under the general supervision of Wells A. Sherman, Specialist in Market Surveys. The corps of clerks who actually compiled and verified the tabulations was led by Henry Hawxhurst, of the Market Surveys Project.

REVISED

CARLOAD FORWARDING REPORT

FOR

U. S. DEPARTMENT OF AGRICULTURE

OF

ALL FRESH OR DRIED FRUITS AND VEGETABLES,

NOT INCLUDING CANNED GOODS OR SUGAR BEETS.

INSTRUCTIONS TO AGENT.

1. Use a separate card for each car.
2. Make a report every day that a carload shipment is loaded at your station, or at a nonagency station for which you do the waybilling, for forwarding over your line.
3. Include nothing rebilled from a connecting line except shipments from a boat line and cars received from a switching line or from another line in switching service.
4. Shipments billed out of storage or storage-in-transit, report as originating at your station.
5. Include imports by water, and all rail imports via your station.

.....,191
(Date of waybill.)

.....
(Billing station.) (State.)

Car No. ..... Initials.....

Contents.....

.....

Use specific commodity names; do NOT report as "Fruits" or "Vegetables." When a mixed car or a car made up of L. C. L. shipments for the same destination contains 60% of any one commodity, report as a straight car of that commodity; otherwise report the principal commodities.

....., ...
(Destination.) (State.)

Signed ....., Agent

..... R. R. Co.

MAIL THIS CARD PROMPTLY; IT REQUIRES NO POSTAGE.

A different form of postal card was sent to the agents of boat lines. Upon these forms unload reports were secured which also stated the points of loading, with the quantity of each commodity forwarded from each point. The quantity was usually expressed in packages or pounds and was reduced in this Bureau to equivalent carloads.

There were received during 1916 reports of the shipment of 634,175 carloads, originating or billed at 8,798 railroad stations and steamboat wharves.

The purpose of this bulletin is to present in tabulated form the information which has thus been gathered. It is designed to give *shipping* information only. It does not purport to give all the points or areas of production or to represent their relative importance. For example, Baltimore, Md., is reported as having shipped 237 carloads of sweet potatoes and 2,170 carloads of white potatoes. It is known, however, that but few of these are grown in the immediate vicinity of that city. A large number are hauled in from Anne Arundel County in trucks, wagons, and small boats. These are sold to dealers, who ship them out to other points. For a similar reason the importance as a producing area of that part of New Jersey near Philadelphia is not fairly represented by the figures showing the shipments from the stations within that territory. Since Philadelphia consumes large quantities of fruits and vegetables, the importance of the adjacent producing areas is not indicated even by the shipments from that city. Similar conditions exist around many other cities and towns. Canneries and drying plants located in producing sections also increase the difficulty of gauging the total production of a section by the shipments reported.

The methods by which most railroads keep their records make it impracticable to distinguish between cars actually loaded at a given point and cars reshipped from that point; therefore, if our reports were complete the total carload shipments would exceed the surplus production of those States which contain numerous storage and distributing points from which large quantities of fruits and vegetables are reshipped. The shipments from a number of seaports include many cars which were imported. While there are a few commodities, such as bananas, which are not grown in this country, there are many others, such as oranges, lemons, and onions, which are of both foreign and domestic origin. As to the latter, it is impossible to determine how many are of domestic origin and therefore already covered by reports from the stations where grown. There is much duplication of this sort in this bulletin, and the reader must not assume that all the shipments credited to large cities and to certain important railroad junctions were of crops actually grown at those points.

Notwithstanding these duplications, the general and prevalent error is one of incompleteness or deficiency. The system of mail reports was not put in operation until after the movement of many crops had begun. It was therefore necessary to request agents to go back over their books and supplement our figures, that we might show the whole year's movement. From many stations it was impracticable to secure complete reports. If only a small number of agents overlook or misunderstand instructions the result is a loss of many cars from the report.

Another cause of shortage is the fact that less than car-lot shipments have been almost wholly ignored. This shortage, while general, is most pronounced in the case of those commodities which are usually shipped in small bulk and for local use, such as berries and green vegetables. This is illustrated by a comparison of the northern and southern strawberry crops. Most southern berries leave the producing point in carloads, while the majority of those grown in the North go into near-by markets in smaller shipments.[1]

However, in the statistical tables devoted to the trucking crops of the Norfolk (Va.) section, the car-lot shipments reported by the carriers have been increased by the total equivalent carloads estimated to have been forwarded in less than car-lot shipments and by boat. This is true also of the shipments reported from the Eastern Shore of Maryland and Virginia. These are two important sections from which reports of the less than car-lot movement were available. On the other hand, the statistics on Minnesota potato shipments appear somewhat smaller than normally because one important carrier furnished reports for the year ended June 30, 1917, instead of for the calendar year 1916.

With but few exceptions the stations listed are those at which there are agents authorized to do way-billing. During 1916 these agents were not requested to give the name of the station at which the commodities were loaded, but only the name of the billing station. In some instances, however, the name of the loading station was furnished instead of the billing station. In most of these cases an effort was made to determine the stations at which the shipments were billed. In general, it was assumed that the first agency station in the direction the shipment was moving would be the one which billed the car. It is realized, however, that this is not always the rule, and that therefore some carloads may have been credited to the wrong billing station.

In general, the shipping season given for each county includes the earliest and latest dates of car loading from any station in the county.

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[1] See Sherman, W. A., Walker, H. F., and Schleussner, O. W., Strawberry Supply and Distribution in 1914. Bulletin 237, U. S. Dept. of Agriculture.

In some instances, however, where information as to the exact shipping season was not available, it was necessary to use the first and last dates reported for the calendar year. In the few cases where shipping dates were not reported, the season was approximated by references to the dates reported from near-by counties. On those commodities whose shipping seasons extend from one calendar year to the next, the season for each county was obtained from the report of the first shipment of the season in 1916 and the closing shipment of the season in 1917. In those cases where no reports are on file for 1917, both the dates for 1916 are taken. It must be remembered, however, that while the shipping dates on those commodities extend from one year to the next, the number of carloads given is the number shipped during the calendar year 1916. The shipping seasons for dry beans and peas are omitted because the information at hand was too meager to be of any value. The shipping seasons for California citrus fruits are not defined because those commodities are shipped practically the whole year from most of the counties in which they are produced.

The statistical tables devoted to dry beans and peas fail to convey an adequate idea of the importance of those crops. Station agents were not requested to include those commodities in their daily reports until the beginning of 1917. Our data for 1916 are very incomplete, being based on reports of shipments voluntarily furnished by the agents. They are also incomplete because much of the movement is in box cars, and complete reports were not available as to the shipments from the West in other than refrigerator cars. This last statement applies also to shipments of dried fruit, particularly dried prunes, and other commodities which may be forwarded in box cars.

A large quantity of deciduous fruit is billed from California as "green fruit" because the cars contain various kinds of fruits, such as apricots, cherries, grapes, nectarines, peaches, pears, persimmons, plums, pomegranates, and quinces. This explains why, in the table devoted to mixed fruit, such a large number of shipments is credited to California, and why a comparatively small number of cars of the specific deciduous fruits is credited to that State.

TOTAL CAR-LOT SHIPMENTS OF FRUITS AND VEGETABLES BY STATES.

State.	DECIDUOUS FRUITS.									
	Apples.	Apricots.	Cherries.	Grapes.	Peaches.	Pears.	Plums.	Prunes.	Quinces.	Mixed fruit.
Alabama	12				10					
Arizona	8			9						
Arkansas	1,523			15	2,040	17				
California	3,340	84	51	3,477	748	391	43	10	3	16,679
Colorado	2,561		3	2	1,112	306		1		104
Connecticut	64				78					
Delaware	255			34	71	240				3
District of Columbia	2									
Florida					2					25
Georgia	73			1	3,300	25				1
Idaho	361		64		5	7		6		83
Illinois	6,158			30	368	288				30
Indiana	610				25	104				2
Iowa	408		3	144	13	5				23
Kansas	1,900			30	2	10				2
Kentucky	193				1	2				
Louisiana	8			2	6	5			1	107
Maine	2,111									
Maryland	1,350		2	127	576	98	2		1	18
Massachusetts	924			6	4	1				11
Michigan	4,215		315	1,849	2,286	816	147		1	20
Minnesota	271		1	5	3	3				53
Mississippi	7				4					
Missouri	3,328			37	210	23				10
Montana	198		1	1						14
Nebraska	803			113	216	13	1			2
Nevada										
New Hampshire	529									
New Jersey	498		16	184	1,179	284				
New Mexico	52					11				
New York	17,579		164	4,585	5,104	2,028	41	3	8	676
North Carolina	466			13	75					1
North Dakota	6									
Ohio	1,689		15	268	2,630	73	5			251
Oklahoma	17				85					
Oregon	3,298		61	26	14	648	3	245		68
Pennsylvania	3,909		1	1,048	494	51	3	3	1	8
Rhode Island	12				3					
South Carolina					22					
South Dakota	33			10	1	1				1
Tennessee	82			1	2	1				
Texas	89			11	1,506	104	1			22
Utah	35				201	24		9		7
Vermont	531									
Virginia	9,263			2	122	2	3		1	1
Washington	13,980	111	116	30	1,504	1,904	29	321		1,128
West Virginia	4,389			1	995	1	2			13
Wisconsin	110		97	1	9	3				3
Wyoming	1									1
Grand total	87,251	195	910	12,062	25,026	7,489	280	598	16	19,367

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	DRIED FRUITS.								
	Dried apples.	Dried apricots.	Dried figs.	Dried peaches.	Dried pears.	Dried prunes.	Raisins.	Dates.	Mixed dried fruit.
Alabama									
Arizona						2			
Arkansas	76								4
California	17	23	57	153	1	300	2,854		211
Colorado									1
Connecticut									
Delaware									
Florida									
Georgia									23
Idaho									
Illinois	23								
Indiana	1								
Iowa									1
Kansas									
Kentucky									
Louisiana									6
Maine									
Maryland	2					1			
Massachusetts									
Michigan	9								
Minnesota	1								
Mississippi									
Missouri	3								29
Montana									
Nebraska									
Nevada									
New Hampshire									
New Jersey				1		1		7	
New Mexico									
New York	667	3	3	58		4	6	14	8
North Carolina	1								
North Dakota									
Ohio									
Oklahoma									
Oregon						25			4
Pennsylvania	17								
Rhode Island									
South Carolina									
South Dakota									
Tennessee	1								
Texas				4					2
Utah									
Vermont	7								
Virginia	43		7						5
Washington		1		1		48			1
West Virginia									3
Wisconsin									
Wyoming									
Grand total	868	27	67	217	1	381	2,860	21	298

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	CITRUS FRUITS.					SUB-TROPICAL FRUITS.			
	Oranges.	Lemons.	Grapefruit.	Limes.	Tangerines.	Bananas.	Fresh figs.	Pineapples.	Pomegranates.
Alabama	21					142			
Arizona	99		2						
Arkansas									
California	37,796	6,829	355	1	6	13	2	1	7
Colorado									
Connecticut									
Delaware									
Florida	11,8[illegible]0		1,874		12			774	
Georgia	22								
Idaho									
Illinois									
Indiana									
Iowa									
Kansas									
Kentucky									
Louisiana	61	28				5,367		3	
Maine									
Maryland	68	42	15			445		3	
Massachusetts	50	7	4		1	2,213			
Michigan									
Minnesota									
Mississippi									
Missouri									
Montana									
Nebraska									
Nevada									
New Hampshire									
New Jersey	95	324	63			44		452	
Mew Mexico									
New York	35	242	13	3		4,699		65	
North Carolina						11			
North Dakota									
Ohio									
Oklahoma									
Oregon	10								
Pennsylvania	40	4				780		5	
Rhode Island	1					1			
South Carolina									
South Dakota									
Tennessee									
Texas	19	5	1	6		2,584			
Utah									
Vermont									
Virginia									
Washington	7	1				2			
West Virginia									
Wisconsin									
Wyoming									
Grand total	50,134	7,482	2,327	10	19	16,301	2	1,303	7

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	BERRIES.									
	Black-berries.	Cran-berries.	Dew-berries.	Goose-berries.	Huckle-berries.	Logan-berries.	Rasp-berries.	Straw-berries.	Mixed berries.	Cur-rants.
Alabama								398		
Arizona										
Arkansas								1,650	48	
California	55				2	62	1	607	2	
Colorado							1	18	6	
Connecticut								42		
Delaware	48							2,043		
Florida								573		
Georgia										
Idaho										
Illinois		5						472		
Indiana	66						30	85		
Iowa								94		
Kansas	1							190	5	
Kentucky								410		
Louisiana								1,354		
Maine										
Maryland	29			1	4		27	2,298	5	
Massachusetts		1,151						160		
Michigan	4	2			34		92	387	8	2
Minnesota								13		
Mississippi								181		
Missouri	5	1					1	1,088		
Montana										
Nebraska		1						9		
Nevada										
New Hampshire										
New Jersey	185	484		3	5		239	843	55	
New Mexico										
New York		1	9	89			88	337	12	177
North Carolina			198		2			765		
North Dakota										
Ohio								48	1	
Oklahoma										
Oregon								109		
Pennsylvania				2	70			67	10	
Rhode Island										
South Carolina								56		
South Dakota										
Tennessee	24							2,506		
Texas	4		3					115	19	
Utah										
Vermont										
Virginia	1				5		8	966	3	
Washington	39						83	84	2	
West Virginia								2		
Wisconsin	3	145		6				74		7
Wyoming										
Grand total	464	1,790	210	101	122	62	570	18,044	176	186

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	CUCURBITOUS CROPS.						SOLANACEOUS CROPS.		
	Cantaloupes.	Casabas.	Cucumbers.	Pumpkins.	Squash.	Watermelons.	Eggplant.	Peppers.	Tomatoes.
Alabama			77			810			
Arizona	491					94			
Arkansas	716					173			4
California	7,926	369	62		3	1,147		16	1,169
Colorado	1,807				1	163			52
Connecticut									
Delaware	905		214			849			1,240
Florida	94		613		24	2,320	110	121	6,184
Georgia	562		1			5,787		2	5
Idaho						59			1
Illinois	142		215	2	10	450	2		336
Indiana	1,070		14	122		620			1,156
Iowa	54			6		542			6
Kansas				2		97			16
Kentucky			1			4			80
Louisiana			30			12	1	5	58
Maine					6				
Maryland	1,244		302			1,063	1	1	644
Massachusetts	1		1		2	1			4
Michigan	38		84	2	1	4			83
Minnesota	2		13	3	19	52			4
Mississippi						29		2	1,663
Missouri	19		8			4,567		2	41
Montana									
Nebraska	1			1	1	44			
Nevada	250					1			
New Hampshire									
New Jersey	107		154	21	2	95	54	893	3,122
New Mexico	63								2
New York	6		146	11		1	1		262
North Carolina	1,141		195			853		12	
North Dakota									
Ohio	17		76	1	14	22			590
Oklahoma	4					1,527			
Oregon	10		2		1	5			3
Pennsylvania	79		12	5		25	3	5	360
Rhode Island						1			
South Carolina	103		508		18	2,665		1	10
South Dakota						7			
Tennessee	31					4		1	796
Texas	80		35			3,324			1,153
Utah	1		3		4	22			67
Vermont					1				
Virginia	60		751		32	1,239	121	5	192
Washington	295	2			5	224			8
West Virginia	2					28			7
Wisconsin			35		5	9			
Wyoming									
Grand total	17,321	371	3,552	176	149	28,939	293	1,066	19,323

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	TUBER CROPS.		BULB CROPS.		ROOT CROPS.					
	White potatoes.	Sweet potatoes.	Garlic.	Onions.	Beets.	Carrots.	Parsnips.	Radishes.	Rutabagas.	Turnips.
Alabama	215	419		3				27	7	7
Arizona	57									
Arkansas	537	413		6				5		12
California	7,605	591	30	2,201		4		1		4
Colorado	11,028	8		394		4	1			6
Connecticut	9			7		3				
Delaware	121	1,778								
Florida	2,004	64		1						
Georgia	114	159		8				1		4
Idaho	6,808			57						
Illinois	1,293	281		616	49	69	13	2	2	32
Indiana	365	1		1,161		5	3	4		9
Iowa	645	6		434						
Kansas	1,411	10		39			1			70
Kentucky	1,399	6		317	35	11		2		10
Louisiana	1,254	467	31	497	12	98		31		3
Maine	31,228					7				8
Maryland	4,675	1,196		145		2				28
Massachusetts	160			3,210	4	9				13
Michigan	14,159			417		32	15		16	28
Minnesota	18,191			459		2			37	22
Mississippi	128	130		1	26	121		1		7
Missouri	423	3		38						19
Montana	967			7		1				
Nebraska	3,125			14						
Nevada	820			50						
New Hampshire	287			3						
New Jersey	13,007	1,536		918						31
New Mexico	42	2		5						
New York	10,765	6	1	2,270	16	217				36
North Carolina	2,282	712		1	10	2				
North Dakota	2,758									1
Ohio	821	3		1,956	97	20	1	1		8
Oklahoma	1,424	7		2						
Oregon	2,644	13	1	467						
Pennsylvania	3,819	12		258		37			3	13
Rhode Island	57			9						
South Carolina	1,264				67	86		21		
South Dakota	1,622			2						
Tennessee	43	170								
Texas	1,649	553		4,778						
Utah	321			43						1
Vermont	314			6	1					3
Virginia	24,042	7,147		319	71	7		375	13	17
Washington	4,338	2		662		1			8	17
West Virginia	59			2						1
Wisconsin	11,281			260		3	1		118	10
Wyoming	171									
Grand total	191,751	15,695	63	22,043	388	741	35	471	204	420

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	BRASSICAS.					SALAD CROPS.			PERENNIALS.		
	Broccoli.	Brussels sprouts.	Cabbages.	Cauliflower.	Kale.	Celery.	Lettuce.	Parsley.	Artichokes.	Asparagus.	Rhubarb.
Alabama			460								
Arizona			1				17				
Arkansas			1								
California	2		953	1,326		2,545	1,244		306	622	146
Colorado			2,740	3		370	24				
Connecticut											4
Delaware											
Florida			867		5	3,002	1,528				
Georgia			4								
Idaho			13			13					
Illinois			185	4		11	27			142	102
Indiana			57			5					1
Iowa			367				1				
Kansas			26								
Kentucky			176	2							
Louisiana			410	20			13	5			
Maine			16								
Maryland			528	1	7	28	4			14	
Massachusetts			22				1			1	
Michigan			263			2,164	14			1	
Minnesota			266				21				
Mississippi			395				1				
Missouri			18				1				
Montana			7								
Nebraska			27			1					
Nevada											
New Hampshire											
New Jersey			16			95	88			403	
New Mexico			13								
New York		100	6,260	1,483		1,658	1,062				
North Carolina			336				83				
North Dakota			1								
Ohio			187			33	78				
Oklahoma			3								
Oregon	48		25			1	3				4
Pennsylvania			182	23		266	111	1	1	40	
Rhode Island			4								
South Carolina			1,011				132			43	
South Dakota			2								
Tennessee			85								
Texas			1,115			2	122				
Utah			7								
Vermont			10								
Virginia			3,289	10	2,567		124	12		5	
Washington			59				1			1	13
West Virginia			10								
Wisconsin			4,088			1					
Wyoming											
Grand total	50	100	24,505	2,872	2,579	10,195	4,700	18	307	1,272	270

Total car-lot shipments of fruits and vegetables by States—Continued.

State.	PULSE CROPS.			DRY PULSE CROPS.		MISCELLANEOUS CROPS.				Grand totals of the 77 commodities.
	Green lima beans.	String beans.	Green peas.	Dry beans.	Dry peas.	Green corn.	Spinach.	Mixed vegetables.	Mixed fruit & vegetables.	
Alabama		40	4	66	8			29	4	2,759
Arizona					57					837
Arkansas					18			2	2	7,262
California			39	1,321	16	2		2,347	163	106,341
Colorado			2	103	95			422	2	21,340
Connecticut		1	9				2	6		225
Delaware		1	15		8					7,825
Dist. of Col										2
Florida	10	178	3	1		6		116		32,321
Georgia		4	2	1				70	1	10,170
Idaho				4	3			2		7,486
Illinois	1	19	7	3		43	9	211	881	12,533
Indiana			42			32		2	6	5,598
Iowa			2			7		3	33	2,797
Kansas								10		3,822
Kentucky		2	1			1		43	225	2,921
Louisiana		31	27	12	16	245		394	145	10,765
Maine						2		2	1	33,381
Maryland		374	52	58		6	39	49	364	15,9.9
Massachusetts		1					3	4	19	7,988
Michigan		41		1,758	73	28		121	3,537	33,071
Minnesota				24	2			88	108	19,663
Mississippi		142	66					278		3,182
Missouri		1				2	1	7	60	9,945
Montana					51			21	1	1,269
Nebraska						3		5		4,380
Nevada								6	15	1,142
New Hampshire								1		820
New Jersey	30	386	70	9	2	165	1	400	1,693	28,260
New Mexico				251				11		452
New York	157	87	144	347	12	15	35	242	88	62,149
North Carolina		128	9	3	4	204		54	32	7,593
North Dakota										2,766
Ohio					1	46		59	711	9,722
Oklahoma								1	1	3,071
Oregon					6			117	1	7,862
Pennsylvania		6		1	10	3	4	55	431	12,278
Rhode Island							11			99
South Carolina		252	27			1		339		6,626
South Dakota								4		1,683
Tennessee		3	2	2				1		3,755
Texas		21	2	5		2	180	317	14	17,847
Utah						1		57	2	805
Vermont		5		12		12		2		904
Virginia		983	430	17	21	4	2,368	23	73	54,749
Washington					5			232	11	25,276
West Virginia				1		1		12	4	5,533
Wisconsin				21	272	10		44	171	16,787
Wyoming								1		174
Grand total	198	2,706	955	4,020	680	841	2,653	6,210	8,799	634,175

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CAR-LOT SHIPMENTS OF FRUITS AND VEGETABLES BY STATIONS.

DECIDUOUS FRUITS.

Table 1.—APPLES.

ALABAMA.

	Cars.
Calhoun County:	
Aug. 15–23—	
DeArmanville	2
Jefferson County:	
May 1–June 12—	
Brimingham	7
Madison County:	
June 21–22—	
Harvest	2
Mobile County:	
Jan.—	
Mobile	1
Ala., State total	12

ARIZONA.

Yavapai County:	
Oct.– Nov.—	
Kirkland	4
Skull Valley	4
Ariz., State total	8

ARKANSAS.

Benton County:	
July–May—	
Avoca	76
Beaty	1
Bentonville	142
Cave Springs	25
Centerton	86
Decatur	22
Felker	12
Garfield	29
Gentry	59
Gravette	28
Healing	8
Highfill	11
Hiwassee	50
Lowell	100
Rogers	92
Siloam Springs	16
Springtown	26
Boone County:	
Aug. 12–Dec. 31—	
Alpena	22
Batavia	8
Bellefonte	15
Bergman	1
Harrison	18
Carroll County:	
Aug. 25–Oct. 19—	
Berryville	3
Green Forest	31
Crawford County:	
Aug. 10–25—	
Mountainburg	2
Cross County:	
Sept. 14–Oct. 5—	
Vanndale	2
Wynne	2
Franklin County:	
Sept. 20—	
Ozark	2
Izard County:	
Sept. 23—	
Ruddells	1
Logan County:	
Oct. 30—	
Paris	5

ARKANSAS Continued.

	Cars.
Madison County:	
Aug. 1—	
Crosses	1
Polk County:	
Aug. 17—	
Hatfield	1
Pope County:	
Aug.—	
Galla	2
Searcy County:	
Aug.—	
Leslie	2
Sebastian County:	
Jan. 6–Apr. 17—	
Fort Smith	92
Washington County:	
July–June—	
Elkins	35
Farmington	14
Greenland	5
Lincoln	144
Prairie Grove	16
Springdale	230
Summers	33
Tontitown	40
West Fork	13
Ark., State total	1,523

CALIFORNIA.

Alameda County:	
Sept.–Mar.—	
Oakland	4
Pleasanton	1
Eldorado County:	
Sept. 30—	
Placerville	1
Fresno County:	
Dec. 8—	
Fresno	1
Kern County:	
Dec. 6–Apr. 4—	
Bakersfield	1
Mojave	1
Los Angeles County:	
Aug.–May—	
Lancaster	4
Laws	14
Los Angeles	28
Palmdale	13
Pomona	1
San Pedro	56
Monterey County:	
Aug. 19–Dec. 3—	
Chualar	6
Metz	2
Salinas	1
Soledad	12
Spreckles	7
Watsonville Junction	19
Napa County:	
June 27–July 19—	
Napa	17
Riverside County:	
July 6–Oct. 17—	
Beaumont	42
Sacramento County:	
June 7–July 27—	
Sacramento	5

CALIFORNIA Continued.

	Cars.
San Benito County:	
Aug. 9–Dec. 19—	
Aromas	143
Hollister	8
San Bernardino County:	
Sept. 16–Oct. 15—	
Hesperia	2
San Diego County:	
Sept. 25—	
Escondido	2
San Francisco County:	
July–Apr.—	
San Francisco	97
San Joaquin County:	
Aug. 17–Oct. 19—	
Stockton	2
Santa Barbara County:	
Sept. 12–Nov. 2—	
Guadalupe	1
Lompoc	3
Santa Maria	5
Santa Clara County:	
July 6–Nov. 9—	
Alviso	12
Gilroy	1
Milpitas	1
San Jose	4
Santa Clara	7
Sargent	9
Santa Cruz County:	
July–May—	
Aptos	122
Capitola	54
Santa Cruz	1
Watsonville	2,264
Sonoma County:	
July 6–Nov. 11—	
Dundee	1
Graton	30
Healdsburg	8
Petaluma	7
Santa Rosa	3
Sebastopol	272
Shellville Junction	5
Trenton	13
Vinaburg	7
Tuolumne County:	
Sept. 19–Nov. 17—	
Sonora	10
Yuba County:	
June 4–21—	
Marysville	10
Cal., State total	3,340

COLORADO.

Alamosa County:	
Oct. 7—	
Alamosa	1
Boulder County:	
Oct. 1–Dec. 15—	
Boulder	5
Longmont	2
Lyons	7
Crowley County:	
Sept. 16–Dec. 23—	
Olney Springs	21
Delta County:	
Aug. 15–Dec. 19—	
Austin	188
Hotchkiss	32
Paonia	437

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

COLORADO—Continued.

	Cars.
Denver County:	
Oct.–Jan.—	
Denver	37
Fremont County:	
Oct.–Apr.—	
Canon City	211
Florence	2
Garfield County:	
Dec.–Mar.—	
Grand Valley	42
Silt	5
La Plata County:	
Dec.–Jan.—	
Durango	6
Larimer County:	
Aug. 26–Feb.—	
Fort Collins	90
Harmony	3
Mesa County:	
Aug. 19–Dec. 28—	
Clifton	792
Fruita	168
Grand Junction	251
Loma	1
Palisade	90
Patterson	9
Montezuma County:	
Sept. 19–Dec. 26—	
Dolores	47
Montrose County:	
Aug.–Jan.—	
Montrose	87
Olathe	13
Otero County:	
Aug.—	
Weitzer	4
Pueblo County:	
Apr. 10–12—	
Pueblo	3
Washington County:	
Aug.—	
Akron	4
Weld County:	
Sept. 1–Dec. 8—	
Greeley	1
Johnstown	2
Colo., State total	2,561

CONNECTICUT.

Hartford County:	
Sept. 3–Nov. 2—	
Collinsville	1
East Hartford	2
Simsbury	3
Litchfield County:	
Oct. 3–Dec. 13—	
Bantam	1
Falls Village	3
New Milford	1
New Preston	4
Washington	3
West Cornwall	1
Middlesex County:	
Oct. 13—	
Deep River	1
New Haven County:	
Oct.–Feb.—	
Wallingford	5
Yalesville	3
Tolland County:	
Oct. 9–Nov. 25—	
Andover	2
Eagleville	2
Windham County:	
Sept. 19–Feb.—	
Abington	3
Pomfret	18
Putnam	11
Conn., State total	64

DELAWARE.

	Cars.
Kent County:	
July 1–Nov. 4—	
Clayton	9
Woodside	64
Wyoming	156
Sussex County:	
June 29–Aug. 29—	
Bridgeville	25
Dagsboro	1
Del., State total	255

DISTRICT OF COLUMBIA.

Mar. 23–Apr. 15—	
Washington	2
Dist. of Col., total	2

GEORGIA.

Fannin County:	
Sept. 29–Oct. 13—	
Blue Ridge	2
Fulton County:	
Nov. 11–Dec. 18—	
Atlanta	2
Gordon County:	
July 24—	
Oostanaula	1
Habersham County:	
Sept.–June—	
Cornelia	57
Rabun County:	
Sept. 25–Nov. 25—	
Clayton	4
Mountain City	7
Ga., State total	73

IDAHO.

Ada County:	
Jan. 7–Feb. 24—	
Boise	9
Adams County:	
Oct. 31–Nov. 14—	
Council	5
Bannock County:	
Nov. 6—	
Pocatello	1
Bingham County:	
Jan. 14–Feb. 24—	
Blackfoot	2
Shelley	1
Booneville County:	
Feb. 14–Apr. 5—	
Idaho Falls	1
Iona	1
Canyon County:	
Oct.–June—	
Emmett	1
Fruitland	44
Nampa	5
New Plymouth	10
Parma	4
Payette	31
Cassia County:	
Oct. 17—	
Burley	1
Kootenai County:	
Oct. 25–Feb.—	
Coeur d'Alene	5
Grand Junction	1
Post Falls	12
Latah County:	
Nov.–Mar.—	
Moscow	4
Nez Perce County:	
Sept.–Mar.—	
Lewiston	202

IDAHO—Continued.

	Cars.
Twin Falls County:	
Feb. 18–Apr. 13—	
Buhl	1
Kimberly	3
Twin Falls	5
Washington County:	
Nov.–Apr.—	
Weiser	12
Idaho, State total	361

ILLINOIS.

Adams County:	
Aug.–June—	
Coatsburg	2
Fall Creek	102
Fowler	12
Quincy	135
Ursa	7
Bond County:	
Aug.–Mar.—	
Greenville	3
Mulberry Grove	6
Smithboro	1
Sorento	5
Brown County:	
Sept. 1–Oct. 31—	
Mount Sterling	14
Timewell	25
Versailles	2
Bureau County:	
Nov.–Jan.—	
Princeton	4
Calhoun County:	
Aug. 20–Nov. 19—	
Auers	7
Beech's	4
Brocks	2
Burr Oak	14
Calhoun	11
Church's	2
Fruitland	6
Golden Eagle Ldg	21
Hamburg	77
Hastings	7
Hogville	28
Maple Island	11
Martins	34
Poppleton	4
Reds	13
Rip Rap	12
Royal	2
Sevier	58
Sunset Landing	22
Turners	46
West Point	55
Willow Bar	26
Champaign County:	
July–June—	
Champaign	36
Savoy	4
Christian County:	
Oct. 9–11—	
Pana	3
Clark County:	
Oct.–Feb.—	
Casey	2
Marshall	1
Martinsville	7
Clay County:	
Aug.–June—	
Clay City	49
Flora	363
Iola	40
Louis	64
Xenia	17
Clinton County:	
Sept. 10–Oct. 11—	
Keysport	2
Posey	3

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

ILLINOIS—Continued.

	Cars.
Coles County:	
Oct. 19—	
Mattoon	1
Oakland	1
Cook County:	
July–June—	
Chicago	247
Crawford County:	
Sept. 20–Nov. 21—	
Hutsonville	3
Oblong	13
Robinson	101
Cumberland County:	
Sept.–June—	
Bradbury	1
Greenup	8
Hazel Dell	6
Jewett	6
Neoga	178
Toledo	27
Effingham County:	
Aug. 2–Nov. 11—	
Altamont	6
Dexter	7
Dieterich	6
Edgewood	83
Effingham	33
Shumway	1
Teutopolis	2
Watson	22
Fayette County:	
Aug.–Oct.—	
Farina	21
Hagerstown	11
Laclede	9
Ramsey	14
St. Elmo	5
St. James	2
Shobonier	4
Fulton County:	
Oct.—	
Astoria	3
Farmington	20
Gallatin County:	
Sept. 14–Nov. 2—	
Omaha	30
Greene County:	
July 11–Nov. 6—	
Drake	96
Greenfield	8
Hillview	289
Roodhouse	18
Hamilton County:	
Sept.—	
Thackery	1
Hancock County:	
Oct. 15–27—	
Dallas City	1
Warsaw	2
Henderson County:	
Oct. 19–Nov. 28—	
Gladstone	4
Jackson County:	
Sept.–June—	
Boskydell	4
Carbondale	2
Makanda	47
Murphysboro	54
Pomona	6
Jasper County:	
Aug.–May—	
Hunt	16
Newton	129
West Liberty	49
Willow Hill	7
Yale	42
Jefferson County:	
July 5—	
Ina	1

ILLINOIS—Continued.

	Cars.
Jersey County:	
Sept.–Jan.—	
Grafton	127
Jerseyville	89
Johnson County:	
June 28–Oct. 20—	
Buncombe	1
Goreville	10
New Burnside	63
Ozark	9
Tunnel Hill	1
Kankakee County:	
July—	
Kankakee	1
Knox County:	
Oct.—	
Galesburg	6
Wataga	2
Yates City	1
Lawrence County:	
Oct. 4–Apr. 30—	
Lawrenceville	57
Sumner	36
McDonough County:	
Oct. 15–30—	
Macomb	1
McLean County:	
Nov.–Mar.—	
Bloomington	5
Macon County:	
Oct.—	
Mount Zion	1
Macoupin County:	
Sept. 9–Oct. 25—	
Brighton	1
Carlinville	126
Hettick	1
Medora	2
Piasa	14
Plainview	36
Shipman	3
Madison County:	
Sept. 8–Nov. 7—	
Alton	180
Collinsville	1
East Alton	1
Marion County:	
July–June—	
Brubaker	9
Cartter	34
Centralia	42
Iuka	20
Kell	36
Kinmundy	17
Patoka	11
Salem	21
Sandoval	20
Tonti	60
Vernon	7
Walnut Hills	33
Montgomery County:	
Sept.–Oct.—	
Irving	26
Raymond	2
Thomasville	1
Morgan County:	
Oct. 10–12—	
Arnold	2
Jacksonville	3
Meredosia	2
Waverly	2
Moultrie County:	
Oct.—	
Sullivan	5
Peoria County:	
July–Apr.—	
Peoria	37
Perry County:	
Nov.–June—	
Du Quoin	16

ILLINOIS—Continued.

	Cars.
Pike County:	
Aug. 15–Nov. 21—	
Barry	176
Hulls	70
Kinderhook	1
Nebo	66
New Canton	52
Pearl	175
Pittsfield	42
Pleasant Hill	117
Rockport	19
Valley City	386
Pope County:	
Sept.—	
Brownfield	2
Pulaski County:	
July 17—	
Villa Ridge	1
Randolph County:	
Oct. 16–Nov. 20—	
Chester	2
Richland County:	
July–May—	
Calhoun	10
Claremont	54
Dundas	4
Jonathan	5
Noble	18
Olney	101
Parkersburg	58
Rock Island County:	
July—	
Port Byron	3
St. Clair County:	
Oct.–June—	
Belleville	8
Broadway	1
East St. Louis	48
Saline County:	
July 8–Oct. 16—	
Stonefort	3
Sangamon County:	
Dec.–May—	
Springfield	10
Scott County:	
Sept.–Oct. 16—	
Alsey	2
Naples	1
Shelby County:	
Sept.–Jan.—	
Cowden	3
Fancher	3
Herrick	1
Mode	4
Oconee	1
Stewardson	4
Tower Hill	1
Union County:	
June 24–Oct. 25—	
Alto Pass	90
Anna	45
Balcom	9
Cobden	120
Dongola	2
Vermilion County:	
Sept. 16–Oct. 25—	
Danville	1
Westville	3
Wabash County:	
Aug.–June—	
Griggsville	127
Mt. Carmel	23
Washington County:	
Sept. 12–Oct. 16—	
Bois	8
Irvington	2
Wayne County:	
Aug. 1–Nov. 3—	
Fairfield	29
Geff	12
Sims	4

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

ILLINOIS—Continued.

	Cars.
White County:	
Oct. 5-19—	
Carmi	7
Whiteside County:	
Aug. 18-Jan. 8—	
Sterling (Rock Falls)	4
Will County:	
Oct. 28-Nov. 8—	
Joliet	3
Williamson County:	
Oct.—	
Creal Springs	18
Ill., State total	6,158

INDIANA.

Bartholomew County:	
July 11-13—	
Columbus	3
Brown County:	
Oct.—	
Helmsburg	8
Cass County:	
Jan. 1-Feb. 14—	
Logansport	2
Clark County:	
Oct. 7—	
Borden	1
Clay County:	
July-May—	
Brazil	11
Clinton County:	
Feb. 5-11—	
Frankfort	3
Daviess County:	
May 10—	
Odon	2
Washington	1
Dekalb County:	
Nov.—	
Auburn	8
St. Joe	1
Fayette County:	
Oct.—	
Nulltown	1
Floyd County:	
Apr. 17-25—	
New Albany	2
Franklin County:	
Sept. 18-Oct. 28—	
Laurel	5
Fulton County:	
Aug.-Mar. —	
Rochester	13
Gibson County:	
Sept.-May—	
Buckskin	12
Hazelton	6
Oakland City	1
Princeton	2
Greene County:	
Oct. 3—	
Worthington	1
Hancock County:	
Sept.-Oct. —	
Greenfield	10
Hendricks County:	
April 20—	
Amo	1
Henry County:	
Nov.—	
Springport	1
Jackson County:	
Aug.-May—	
Reddington	2
Seymour	4
Vallonia	3
Jasper County:	
Mar. 1—	
Fair Oaks	1

INDIANA—Continued.

	Cars.
Jefferson County:	
July 29-Oct. 26—	
Dupont	7
Madison	8
Middle Fork	3
Jennings County:	
Oct. 14—	
Butterville	1
Grayford	2
Johnson County:	
Aug. 10-Oct. 13—	
Greenwood	8
Knox County:	
Sept.-June —	
Bicknell	1
Fritchton	8
Vincennes	230
Westphalia	9
Lake County:	
Aug. 16-31—	
Highlands	7
Lawrence County:	
Sept. 15-Nov. 10—	
Bedford	13
Mitchell	7
Marion County:	
Aug. 1-May—	
Augusta	2
Indianapolis	2
Martin County:	
Oct. 6-27—	
Burns City	4
Miami County:	
Sept. 22-Oct. 28—	
Peru	5
Monroe County:	
Oct. 1—	
Elwren	1
Montgomery County:	
Sept.—	
Waynetown	1
Morgan County:	
Sept.-June—	
Martinsville	14
Mooresville	4
Newton County:	
Sept.—	
Rose Lawn	1
Orange County:	
July 29-Oct. 16—	
Orleans	26
Owen County:	
Aug. 3-Nov. 13—	
Gosport	10
Spencer	3
Putnam County:	
Aug. 16-Nov. 4—	
Bainbridge	1
Greencastle	19
Reelsville	8
Ripley County:	
Oct. 16—	
Spades	1
St. Joseph County:	
Oct.-Nov.—	
Walkerton	2
Starke County:	
Oct.-Dec.—	
Hamlet	1
Knox	1
North Judson	1
Steuben County:	
Oct.—	
Angola	2
Vanderburg County:	
Sept.-June—	
Evansville	83
Wabash County:	
Oct. 7-12—	
Laketon	3

INDIANA—Continued.

	Cars.
Washington County:	
Oct. 14-Nov. 2—	
Campbellsburg	4
Ind., State total	610

IOWA.

Blackhawk County:	
Jan. 13—	
Waterloo	1
Cass County:	
Aug.-Oct.—	
Griswold	4
Clinton County:	
Aug.—	
Clinton	20
Dallas County:	
Sept.—	
Dexter	1
Des Moines County:	
Oct.—	
Burlington	16
Dickinson County:	
Oct.—	
Spirit Lake	1
Dubuque County:	
Dec.-May—	
Dubuque	23
Fayette County:	
Aug. 15-Mar.—	
Fayette	2
Oelwein	2
West Union	1
Fremont County:	
Aug. 1-Dec. 15—	
Hamburg	43
Percival	2
Sidney	9
Grundy County:	
Oct. 16—	
Wellsburg	1
Harrison County:	
Aug. 8-Apr.—	
Logan	2
Missouri Valley	17
Mondamin	11
Woodbine	1
Henry County:	
Aug.—	
Salem	3
Iowa County:	
Oct. 7-18—	
Williamsburg	7
Jefferson County:	
Nov.-May—	
Fairfield	24
Kossuth County:	
Oct. 4-Nov. 3—	
Luverne	3
Lee County:	
Sept. 10-Oct. 25—	
Montrose	45
Wever	1
Louisa County:	
Oct. 21—	
Newport	1
Madison County:	
Oct. 1-30—	
Bevington	4
Mahaska County:	
Oct. 7-28—	
Oskaloosa	2
Marion County:	
Sept.—	
Hamilton	1
Mills County:	
Oct.-Jan.—	
Balfour	1
Glenwood	17
Malvern	33
Pacific Junction	30

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

IOWA—Continued.

	Cars.
Page County:	
Oct. 1–Nov. 1—	
Shambaugh	7
Polk County:	
Sept.—	
Des Moines	14
Pottawattamie County:	
Aug. 3–Oct. 16—	
Council Bluffs	9
Scott County:	
Sept.–Nov. 20—	
Davenport	11
Van Buren County:	
Aug.—	
Selma	3
Wapello County:	
Oct.–May—	
Eddyville	10
Farson	1
Highland	7
Ottumwa	10
Warren County:	
Nov. 25—	
Carlisle	1
Washington County:	
Oct.—	
Brighton	1
Webster County:	
Oct.—	
Fort Dodge	5
Iowa, State total	408

KANSAS.

Atchison County:	
July 30–Nov. 21—	
Atchison	89
Oak Mills	4
Potter	30
Brown County:	
Sept. 10–Oct. 10—	
Padonia	2
Reserve	3
Cherokee County:	
Sept. 15—	
Scammon	1
Cowley County:	
Oct. 11—	
Arkansas City	1
Dickinson County:	
Dec.–Mar.—	
Solomon	2
Doniphan County:	
Aug. 4–Nov. 15—	
Bendena	2
Blair	41
Doniphan	12
Fanning	6
Highland	4
Moray	13
Severance	9
Sparks	8
Troy	588
Troy Jct	8
Wathena	271
White Cloud	10
Douglas County:	
Oct. 12–Nov. 27—	
Baldwin	3
Lawrence	2
Vinland	2
Ellis County:	
Dec. 26—	
Victoria	1
Ellsworth County:	
Nov.–Jan.—	
Kanopolis	4
Harvey County:	
Jan. 1–Apr. 30.—	
Newton	77

KANSAS—Continued.

	Cars.
Jefferson County:	
Oct. 5–28—	
Grantville	4
Meriden	2
Oskaloosa	4
Perry	1
Winchester	3
Jewell County:	
Oct.—	
Mankato	1
Johnson County:	
Oct. 26–Nov. 3—	
Gardner	4
Holliday	6
Kearney County:	
Oct. 26—	
Kearney	2
Kingman County:	
Oct. 11—	
Cunningham	1
Leavenworth County:	
July-May—	
Jarbalo	9
Lansing	20
Leavenworth	49
Lowemont	15
Tonganoxie	25
Linn County:	
Aug. 4–Nov. 3—	
Parker	41
Morris County:	
Oct.–Mar.—	
Council Grove	6
Pottawatomie County:	
Sept. 24.—	
St. Mary's	1
Reno County:	
Aug.-Jan.—	
Hutchinson	205
Medora	1
Riley County:	
Nov. 17—	
Randolph	1
Rooks County:	
Oct. 9—	
Damar	1
Russell County:	
Oct. 24–Nov. 4—	
Gorham	2
Saline County:	
Oct.–May—	
Salina	12
Sedgwick County:	
Aug. 16–Oct. 18—	
Peck	1
Valley Center	13
Wichita	2
Shawnee County:	
Nov.–Jan.—	
Topeka	29
Smith County:	
Nov.—	
Bellaire	2
Smith Center	3
Sumner County:	
July 27–Nov. 4—	
Belle Plaine	72
Mulvane	3
Oxford	4
Perth	1
Washington County:	
Oct. 15–Nov. 30—	
Haddam	1
Morrow	1
Wyandotte County:	
Sept. 11–Dec. 5—	
Menager Junction	155
Piper	1
Wolcott	2
Kans., State total	1,900

KENTUCKY.

	Cars.
Breckinridge County:	
Sept. 26–Oct. 1—	
Stephensport	1
Webster	1
Fayette County:	
Oct.—	
Lexington	1
Hardin County:	
Aug. 30—	
St. John	1
Henderson County:	
Sept.–May—	
Baskett	6
Henderson	53
Robards	2
Jefferson County:	
Oct.–May—	
Louisville	115
Oldham County:	
Oct.—	
Crestwood	12
Webster County:	
Oct. 17—	
Dixon	1
Ky., State total	193

LOUISIANA.

Orleans Parish:	
Nov. 1–Dec. 19—	
New Orleans	8
La., State total	8

MAINE.

Androscoggin County:	
Sept.–May—	
Auburn	105
Danville Junction	1
East Livermore	9
Elmwood	1
Empire Road	8
Greene	82
Leeds Center	1
Lewiston	2
Lisbon	3
Lisbon Falls	1
Livermore Falls	89
Mechanic Falls	14
North Leeds	16
Poland	22
Riccars	6
Sabattus	31
West Minot	45
Aroostook County:	
Sept.—	
Caribou	1
Houlton	1
Mapleton	2
New Sweden	2
Perham	4
Cumberland County:	
Oct.–Apr.—	
Bridgton	6
Cornish	48
Gorham	1
Gray	5
Harrison	25
Mattocks	16
New Gloucester	22
North Bridgton	1
North Yarmouth	1
Portland	7
Rowes	1
Sebago Lake	15
Steep Falls	16
West Baldwin	13
West Falmouth	1

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

MAINE—Continued.

	Cars.
Franklin County:	
Sept.-May—	
East Wilton	48
Farmington	43
Jay	1
Jay Bridge	19
North Jay	77
Phillips	10
Salem	5
West Farmington	88
Wilton	82
Kennebec County:	
Aug.-May—	
Albion	1
Annabessacook	12
Augusta	5
Belgrade	12
China	7
Gardiner	18
Hallowell	4
Monmouth	100
North Belgrade	7
Oakland	15
Readfield	6
Riverside	2
Vassalboro	10
Waterville	13
Weeks Mills	6
Winslow	2
Winthrop	58
Knox County:	
Nov.-Jan.—	
Rockland	1
Union	25
Lincoln County:	
Oct. 24-Dec. 4—	
Cooper's Mills	1
Head Tide	8
North Whitefield	2
South New Castle	3
Winslows Mills	1
Oxford County:	
Sept.-May—	
Bethel	6
Brownfield	9
Bryant's Pond	3
Buckfield	52
Canton	16
East Hebron	130
East Peru	1
East Sumner	29
Fryeburg	4
Gilbertville	1
Hartford	35
Locke's Mills	3
Norway	44
Oxford	12
Peru	4
Rumford	3
South Paris	74
West Paris	75
Penobscot County:	
Sept.-Mar.—	
Bangor	5
Dexter	8
East Newport	6
Etna	14
Hampden	4
Herman Pond	17
Hudson	1
Newport Junction	2
North Bangor	2
Staceyville	1
Piscataquis County:	
Oct.-Jan.—	
Dover and Foxcroft	11
Guilford	1
Monson Junction	1
South Sebec	1
Sagadahoc County:	
Nov. 7-Jan.—	
Bowdoinham	9
Richmond	4

MAINE—Continued.

	Cars.
Somerset County:	
Oct. 3-Mar.—	
Anson	7
Bingham	1
Fairfield	3
Hinckley	13
Madison	1
Norridgewock	16
North Anson	24
Pittsfield	4
Shawmut	2
Skowhegan	24
Solon	6
Waldo County:	
Nov.-Mar.—	
Belfast	24
Brooks	13
Frankfort	2
Palermo	10
Unity	5
Waldo	5
Winterport	7
York County:	
Oct.-Jan.—	
Alfred	2
Bradbury	5
Eastwood	3
Eliot	22
North Berwick	1
Springvale	3
Waterboro	1
York Harbor	3
Me., State total	2,111

MARYLAND.

Allegany County:	
Sept. 18-Nov. 29—	
Cumberland	11
Rawlings	1
Town Creek	14
Baltimore City:	
July-June—	
Baltimore	122
Canton	1
Baltimore County:	
Oct. 21-31—	
White Hall	2
Caroline County:	
July 13-19—	
Federalsburg	2
Carroll County:	
Sept. 1-Dec.—	
Asbestos	1
Carrollton	7
Melrose	1
New Windsor	39
Westminster	5
Frederick County:	
Sept. 23-Nov. 18—	
Deerfield	27
Emmitsburg	6
Frederick	17
Myersville	14
Thurmont	6
Woodsboro	4
Garrett County:	
Nov. 8-Jan.—	
Friendsville	4
Gorman	1
Hutton	1
Oakland	4
Harford County:	
July 23-Nov. 10—	
Bynum	3
Havre de Grace	4
Whiteford	1
Queen Annes County:	
July-Dec. 30—	
Love Point	1

MARYLAND—Continued.

	Cars.
Talbot County:	
July-Aug. 16—	
Claiborne	1
Washington County:	
July-May—	
Antietam	32
Breatheds	8
Cavetown	17
Charlton	3
Chewsville	73
Clearspring	13
Eakle's Mills	12
Edgemont	121
Gapland	4
Hagerstown	211
Hancock	325
Highfield	5
Keedysville	40
Morgansville	9
Pearre	10
Reid	6
Rohrersville	15
St. James	16
Smithsburg	128
July 31:	
Patuxent River landings	1
July:	
Potomac River landings	1
Md., State total	1,350

MASSACHUSETTS.

Berkshire County:	
Oct. 23-Feb.—	
Hinsdale	1
Williamstown	2
Essex County:	
Oct.-Apr.—	
Amesbury	3
Byfield	13
Georgetown	4
Groveland	3
Lawrence	1
Merrimac	1
Newbury	15
Newburyport	27
Rowley	11
Salisbury	7
Franklin County:	
Sept. 27-Dec. 19—	
Bardwell	4
Bernardston	4
Buckland Station	75
Charlemont	26
Conway	1
Greenfield	22
New Salem	2
Shelburne Falls	208
South River	4
Whately	4
Zoar	2
Hampden County:	
Oct. 5-Nov. 15—	
Chester	3
Russell	2
Southwick	4
Hampshire County:	
Sept.-Jan.—	
Hadley	3
Haydenville	14
Huntington	25
North Hatfield	1
Norwottuck	3
Williamsburg	33
Middlesex County:	
Sept. 7-Feb.—	
Ayer	4
Carlisle	1
Chelmsford	2

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

MASSACHUSETTS—Contd.

	Cars.
Middlesex County—Contd.	
Sept. 7–Feb.—	
Dunstable	5
East Littleton	10
Gleasondale	5
Groton	34
Holliston	1
Hopkinton	2
Hudson	7
Lincoln	1
Littleton	59
Lowell	3
Marlboro	10
Nobscot	1
North Pepperell	9
Sherborn	11
Shirley	7
South Acton	7
South Sudbury	5
Townsend	2
Townsend Harbor	3
West Acton	69
West Chelmsford	1
West Graniteville	1
West Townsend	7
Norfolk County:	
Oct. 30—	
Medway	1
Plymouth County:	
Nov. 7—	
Marshfield Hills	1
Suffolk County:	
Nov.–June—	
Boston	14
Worcester County:	
Sept.–Mar.—	
Barre	1
Barre Plains	4
Carters	3
Clinton	4
Fitchburg	7
Gilbertsville	8
Harvard	21
Leominster	1
Northboro	2
North Brookfield	1
North Leominster	3
Otter River	2
Oxford	1
Pratts Junction	10
Southboro	2
Southville	2
Sterling	11
Sterling Junction	9
Still River	5
Warren	3
Westboro	12
Williamsville	1
Mass., State total	924

MICHIGAN.

	Cars.
Alcona County:	
Nov. 24–Dec. 19—	
Harrisville	2
Allegan County:	
Aug. 15–Dec. 15—	
Allegan	126
Bradley	1
Bravo	8
East Saugatuck	4
Fennville	425
Hopkins	11
Moline	5
New Richmond	13
Pullman	56
Shelbyville	10
Antrim County:	
Oct.–Jan.—	
Alden	5
Bellaire	19

MICHIGAN—Continued.

	Cars.
Arenac County:	
Oct.–Nov.—	
Sterling	2
Barry County:	
Sept. 1–Nov.—	
Cloverdale	2
Nashville	7
Benzie County:	
Aug. 19–Mar.—	
Beulah	27
Frankfort	55
Honor	3
Lake Ann	1
Berrien County:	
Aug. 5–April—	
Baroda	6
Benton Harbor	55
Berrien Center	7
Berrien Springs	7
Bridgman	1
Coloma	21
Derby	7
Eau Claire	15
New Buffalo	10
Riverside	4
St. Joseph	3
Sawyer	33
Sodus	17
Three Oaks	6
Watervliet	27
Branch County:	
Aug.—	
Coldwater	1
Calhoun County:	
Aug. 31–Nov.—	
Albion	5
Clarendon	3
Homer	1
Marshall	1
Tekonsha	1
Cass County:	
Sept. 11–Oct. 28—	
Dowagiac	2
Charlevoix County:	
Sept. 9–Nov. 14—	
Charlevoix	5
East Jordan	2
Cheboygan County:	
Sept.–Oct.—	
Aloha	5
Cheboygan	4
Clinton County:	
Oct.–Feb.—	
Ovid	20
St. Johns	2
Delta County:	
Sept. 16—	
Vans Harbor	1
Eaton County:	
Sept.–Dec.—	
Bellevue	1
Eaton Rapids	20
Grand Ledge	1
Emmet County:	
Oct. 13–24—	
Harbor Springs	1
Levering	1
Petoskey	1
Genesee County:	
Oct.–Nov.—	
Fenton	20
Flushing	31
Gladwin County:	
Oct.—	
Gladwin	1
Grand Traverse County:	
Aug. 10–Jan.—	
Bowers Harbor	1
Fife Lake	1
Old Mission	33
Traverse City	108
Williamsburg	2

MICHIGAN—Continued.

	Cars.
Hillsdale County:	
Sept.–Dec.—	
Allen	3
Bankers	5
Hillsdale	6
Jerome	2
Jonesville	6
Litchfield	4
Mosherville	3
North Adams	18
Somerset Center	1
Huron County:	
Oct. 16–Dec. 22—	
Bad Axe	7
Kinde	1
Ingham County:	
Aug. 15–Dec. 6—	
Leslie	165
Mason	20
Onondaga	12
Ionia County:	
Sept. 30–Nov. 30—	
Belding	28
Ionia	16
Muir	18
Orleans	1
Pewamo	3
Portland	4
Saranac	1
Isabella County:	
Oct.–Jan.—	
Shepherd	5
Jackson County:	
Oct.–Feb.—	
Brooklyn	6
Grass Lake	10
Hanover	3
Jackson	13
Parma	2
Rives Junction	5
Springport	27
Kalamazoo County:	
Aug.–Oct.—	
Augusta	5
Galesburg	4
Gull Lake Junction	2
Kalamazoo	18
Williams	1
Kent County:	
Aug. 21–Mar.—	
Alto	1
Byron Center	2
Gooding	38
Grand Rapids	40
Kent City	15
Linden	1
Lowell	14
Moseley	10
Sand Lake	1
Sparta	40
Lapeer County:	
Aug. 23–Feb.—	
Almont	43
Attica	28
Columbiaville	2
Dryden	40
Hunters Creek	19
Imlay City	14
Lapeer	6
Lum	7
Metamora	6
Leelanau County:	
Aug. 24–Dec. 11—	
Empire	7
Glen Arbor	13
Glen Haven	4
Northport	12
Omena	17
Suttons Bay	11

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

MICHIGAN—Continued.

	Cars.
Lenawee County:	
Oct.-Nov.—	
Addison	2
Cadmus	1
Clinton	8
Holloway	8
Onsted	1
Riga	1
Tecumseh	2
Tipton	5
Weston	11
Livingston County:	
Oct.-Feb.—	
Brighton	17
Gregory	4
Hamburg	1
Howell	1
Pinckney	1
Macomb County:	
Oct. 10-Nov. 20—	
Armada	11
Romeo	9
Washington	1
Manistee County:	
Aug. 1-Dec.—	
Arcadia	43
Butwell	2
Chief Lake	4
Copemish	22
Henry	18
Kaleva	3
Malcolm	4
Manistee	18
Norwalk	27
Onekama	12
Sorenson	3
Marquette County:	
Nov. 1—	
Ishpeming	1
Mason County:	
Aug. 7—Nov. 15—	
Custer	11
Ludington	253
Mecosta County:	
Aug. 25-Oct. 15—	
Big Rapids	3
Menominee County:	
Oct. 16-Dec. 16—	
Menominee	6
Monroe County:	
Oct.-Dec.—	
Dundee	28
Montcalm County:	
Oct. 3-Nov. 24—	
Greenville	7
Stanton	1
Muskegon County:	
Aug. 14-Dec. 21—	
Bailey	1
Brunswick	16
Casnovia	61
Muskegon	3
Slocum	5
Newaygo County:	
Aug.-Apr.—	
Fremont	55
Newaygo	4
Reeman	4
Oakland County:	
July-Mar.—	
Clyde	9
Davisburg	16
Elba	2
Highland	5
Holly	5
Leonard	8
New Hudson	9
Novi	50
Orchard Lake	4
Oxford	7
Rochester	2
South Lyon	5

MICHIGAN—Continued.

	Cars.
Oakland County—Continued.	
July-Mar.—	
Thomas	14
Walled Lake	4
Wixom	11
Oceana County:	
Aug. 16-Nov. 30—	
Hart	111
Mears	3
Pentwater	21
Shelby	52
Ogemaw County:	
Oct.—	
West Branch	1
Osceola County:	
Sept. 22—	
Evart	1
Ottawa County:	
Oct. 6-Nov. 23—	
Conklin	14
Coopersville	1
Grand Haven	1
Presque Isle County:	
Sept. 26—	
Rogers City	1
St. Joseph County:	
Aug.-Nov. 2—	
Constantine	4
Fabius	4
Three Rivers	18
Wasepi	1
Sanilac County:	
Oct. 28-Nov. 3—	
Tyre	2
Shiawassee County:	
Oct. 26-Nov. 9—	
Laingsburg	5
Morrice	7
Perry	4
Tuscola County:	
Oct. 1-Nov. 3—	
Akron	2
Mayville	4
Reese	1
Van Buren County:	
July 24-Jan.—	
Bangor	138
Berlamont	20
Bloomingdale	38
Breedsville	40
Covert	40
Gobles	2
Grand Junction	17
Hartford	60
Kibbie	79
Lacota	103
Lawrence	56
Lawton	1
McDonald	16
Paw Paw	3
South Haven	361
Washtenaw County:	
Aug. 15-Nov.—	
Ann Arbor	2
Chelsea	7
Salem	20
Wayne County:	
Oct.-Mar.—	
Detroit	3
Northville	9
Mich., State total	4,215

MINNESOTA.

	Cars.
Beltrami County:	
Oct.—	
Bemidji	5
Big Stone County:	
Oct.-Apr.—	
Beardsley	1
Clinton	1

MINNESOTA—Continued.

	Cars.
Blue Earth County:	
Oct.-Jan.—	
Mankato	11
Carlton County:	
Sept. 30-Oct. 23—	
Carlton	2
Douglas County:	
Oct.—	
Carlos	1
Fillmore County:	
Sept. 22—	
Mabel	1
Goodhue County:	
Oct.—	
Cannon Falls	1
Hennepin County:	
Oct.-June—	
Dayton	3
Minneapolis	135
Houston County:	
Sept. 9-Oct. 21—	
La Crescent	10
Mound Prairie	10
Jackson County:	
Sept.—	
Heron Lake	1
Norman County:	
Oct. 13-17—	
Halstad	13
Ramsey County:	
Nov.-Apr.—	
Minnesota Transfer	8
St. Paul	16
St. Louis County:	
Oct.-June—	
Duluth	49
Watonwan County:	
Sept.—	
Odin	1
Winona County:	
Nov.-Mar.—	
Winona	2
Minn., State total	271

MISSISSIPPI.

	Cars.
Tippah County:	
Sept. 10-21—	
Clarksville	7
Miss., State total	7

MISSOURI.

	Cars.
Adair County:	
Oct. 30—	
Brashear	1
Andrew County:	
Aug. 14-Nov. 4—	
Amazonia	18
Nodaway	4
Savannah	18
Wyeth	3
Atchison County:	
Aug. 14-Oct. 24—	
Fairfax	7
Langdon	2
Tarkio	8
Audrain County:	
Oct. 2-17—	
Mexico	9
Barry County:	
Aug. 23-Dec. 20—	
Exeter	16
Monett	2
Seligman	1
Wheaton	8

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

MISSOURI—Continued.

	Cars.
Barton County:	
Sept. 16—	
Liberal	1
Bates County:	
Sept. 6–Nov. 6—	
Amoret	32
Boone County:	
Aug. 20–Nov.—	
Hallsville	1
Hartsburg	2
McBaine	19
Rochefort	16
Buchanan County:	
July–May—	
Agency Ford	11
De Kalb	58
Easton	5
Faucett	23
Halls	15
Kenmoor	3
Rushville	48
St. Joseph	205
St. Joseph Stock Yards	10
Saxton	10
Wallace	64
Winthrop	2
Callaway County:	
Oct. 10–20—	
Auxvasse	11
Fulton	1
Mokane	1
Carroll County:	
Sept. 14–Nov. 6—	
Carrollton	7
De Witt	9
Miami	10
Standish	2
Wakenda	11
Cass County:	
Sept. 15–Nov. 12—	
Cleveland	38
Chariton County:	
Sept.–Nov.—	
Burnswick	4
Dalton	10
Clay County:	
Oct. 18–Nov. 8—	
Smithville	6
Clinton County:	
Oct. 7—	
Hemple	1
Cole County:	
Oct. 1–31—	
Eugene	4
Jefferson City	1
Cooper County:	
Oct. 14–18—	
Speed	3
Crawford County:	
Sept. 12–15—	
Cuba	25
Dade County:	
Sept. 1–Dec. 1—	
Everton	35
Greenfield	2
Daviess County:	
Nov.—	
Gallatin	2
Jameson	1
Franklin County:	
Aug.–Apr.—	
Boles	4
Gray's Summit	2
Labadie	8
Sullivan	1
Gasconade County:	
Oct. 6–18—	
Bland	2
Owensville	1
Gentry County:	
Oct.—	
King City	1

MISSOURI—Continued.

	Cars.
Greene County:	
Aug.–June—	
Bois D'Arc	2
Haseltine	186
Republic	6
Springfield	129
Turner	3
Willard	7
Grundy County:	
Sept. 10–Oct. 30—	
Dunlap	5
Hickory County:	
Sept. 20–Nov. 11—	
Weaubleau	5
Holt County:	
Aug.–Feb.—	
Corning	11
Craig	27
Forbes	33
Forest City	109
Fortescue	34
Maitland	33
Mound City	3
Howard County:	
Oct. 2–Nov. 21—	
Estill	13
Franklin	34
New Franklin	2
Howell County:	
July 1–Nov. 30—	
Brandsville	8
Burnham	3
Hutton Valley	5
Mountain View	12
Olden	17
Pomona	27
West Plains	23
Willow Springs	18
Jackson County:	
Aug.–June—	
Blue Springs	49
Buckner	1
Courtney	10
Grain Valley	5
Holmes	5
Independence	2
Jeffreys	20
Kansas City	56
Lake City	1
Lees Summit	5
Levasy	1
Sibley	31
Jasper County:	
Nov.–Dec—	
Carthage	2
Laclede County:	
Oct. 10–Nov.—	
Lebanon	8
Lafayette County:	
Aug. 24–Nov. 9—	
Corder	3
Higginsville	5
Hodge	53
Lexington	27
Mayview	142
Napoleon	1
Odessa	5
Waverly	181
Lawrence County:	
Aug. 20–June—	
Aurora	16
Logan	29
Marionville	30
Mt. Vernon	1
Lincoln County:	
Sept. 20–Oct. 18—	
Elsberry	29
Moscow	13
Livingston County:	
Aug. 24–Oct. 15—	
Chillicothe	2
Utica	5

MISSOURI—Continued.

	Cars.
McDonald County:	
Aug. 1–Dec. 30—	
Anderson	22
Goodman	5
Lanagan	14
Macon County:	
Sept. 29–Oct. 20—	
Macon	15
Maries County:	
Sept. 28–Oct. 5—	
Belle	2
Marion County:	
Oct.–June—	
Hannibal	148
Montgomery County:	
Sept. 16–Nov. 1—	
Buell	1
New Florence	4
Rhineland	10
Morgan County:	
Sept. 21–Oct. 14—	
Versailles	2
Newton County:	
Oct.–Apr.—	
Neosho	21
Stark City	4
Nodaway County:	
Sept. 20–Oct. 20—	
Conception	2
Maryville	1
Parnell	6
Skidmore	32
Oregon County:	
July 3–6—	
Koshkonong	2
Perry County:	
Sept. 23–Oct. 31—	
Seventy-Six	14
Pike County:	
June 21–Nov. 8—	
Annada	6
Ashburn	23
Louisiana	20
Platte County:	
Aug. 1–Dec. 15—	
Dearborn	10
East Leavenworth	3
Iatan	55
New Market	1
Parkville	30
Platte City	1
Weston	63
Polk County:	
Aug.1–Oct. 1—	
Flemington	2
Pulaski County:	
Aug. 21–Oct. 7—	
Dixon	24
Putnam County:	
Aug.—	
Unionville	3
Ralls County:	
Aug. 21–Nov. 2—	
Saverton	49
Ray County:	
Sept. 13–Oct. 26—	
Orrick	20
St. Charles County:	
July 1–Nov. 5—	
Beck's	5
Machens	1
Orchard Farm	8
Peruque	4
St. Peters	5
St. Genevieve County:	
Aug.—	
St. Marys	1
St. Louis City:	
Oct. 13–24—	
St. Louis	177
St. Louis County:	
Oct. 13–24—	
Allenton	2

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

MISSOURI—Continued.

	Cars.
Saline County:	
Sept. 16–Oct. 17—	
Grand Pass	28
Shannon County:	
Oct. 3—	
Birchtree	1
Texas County:	
Oct. 3–Nov. 11—	
Cabool	8
Warren County:	
Oct. 17–Nov. 4—	
Truedale	2
Wright City	2
Webster County:	
Sept. 7–Oct. 28—	
Diggins	1
Marshfield	3
Rogersville	11
Seymour	45
Wright County:	
Sept. 8–Dec. 27—	
Cedar Gap	40
Mansfield	6
Mountain Grove	5
Mo., State total	3,328

MONTANA.

Fergus County:	
Dec. 4–21—	
Lewistown	3
Flathead County:	
Jan.–June—	
Somers	10
Lewis and Clark County:	
Jan.–June—	
Helena	2
Missoula County:	
Oct.–Feb.—	
Lo Lo	4
Ravalli County:	
Sept.–Mar.—	
Darby	9
Florence	1
Hamilton	99
Victor	18
Woodside	48
Silverbow County:	
Oct.–Feb.—	
Butte	3
Yellowstone County:	
Jan. 4—	
Billings	1
Mont., State total	198

NEBRASKA.

Adams County:	
Oct. 2—	
Hastings	2
Boyd County:	
Dec. 4—	
Spencer	1
Buffalo County:	
Oct. 26–Nov. 4—	
Kearney	2
Ravenna	1
Burt County:	
Oct. 1–31—	
Oakland	1
Tekamah	4
Butler County:	
Nov. 17—	
Brainard	1
Cass County:	
Aug.–Oct.—	
Nehawka	82
Union	2
Weeping Water	1

NEBRASKA—Continued.

	Cars.
Cheyenne County:	
Nov. 25—	
Sidney	1
Douglas County:	
Sept.–June—	
Florence	2
Irvington	1
Omaha	10
South Omaha	28
Franklin County:	
Sept.—	
Franklin	9
Naponee	2
Frontier County:	
Nov.—	
Eustis	7
Moorefield	2
Hall County:	
Oct. 2–Feb. 25—	
Grand Island	11
Harlan County:	
Sept.—	
Alma	3
Johnson County:	
Oct. 2–14—	
Crab Orchard	2
Tecumseh	1
Kearney County:	
Oct.—	
Axtell	3
Lancaster County:	
Sept.–Jan.:	
Lincoln	8
Lincoln County:	
Nov.–May—	
North Platte	1
Nance County:	
Aug. 30—	
Belgrade	1
Nemaha County:	
Aug.–Dec.—	
Auburn	166
Brownville	56
Howe	9
Julian	1
Nemaha City	10
Peru	21
Rohrs	3
Nuckolls County:	
Sept. 21–29—	
Lawrence	2
Otoe County:	
Aug. 1–Dec. 30—	
Minersville	1
Nebraska City	35
Wyoming	28
Pawnee County:	
Aug. 31–Oct. 12—	
Pawnee City	1
Table Rock	4
Platte County:	
Dec.–April—	
Columbus	2
Redwillow County:	
Sept.—	
Lebanon	3
McCook	3
Marion	3
Richardson County:	
Sept. 1–Nov. 30—	
Dawson	3
Falls City	66
Preston	1
Rulo	22
Salem	8
Shubert	98
Verdon	5
Saunders County:	
Nov. 10—	
Cedar Bluffs	1

NEBRASKA—Continued.

	Cars.
Valley County:	
Dec. 29—	
Ord	1
Washington County:	
Sept. 3–Nov. 8—	
Arlington	47
Blair	14
Nebr., State total	803

NEW HAMPSHIRE.

Belknap County:	
Oct. 13–Nov. 29—	
Alton Bay	1
Barnstead	2
Belmont	1
Center Barnstead	1
Laconia	1
Lockmere	2
Meredith	1
Tilton	2
Carroll County:	
Oct. 1–Dec. 20—	
Burleyville	3
Madison	2
Cheshire County:	
Oct. 9–Nov. 23—	
Cold River	18
Grafton County:	
Oct. 1–Dec. 1—	
Ashland	6
Bristol	2
Grafton	1
Hillsborough County:	
Oct. 2–Jan. —	
Amherst	3
Antrim	16
East Weare	4
Goffstown	1
Greenfield	5
Greenville	8
Hancock	22
Hillsboro	25
Hollis	4
Hudson	2
Mason	1
Milford	5
New Boston	7
North Weare	3
Peterboro	5
Riverdale	1
South Lyndeboro	10
South Merrimack	1
Wilton	43
Merrimack County:	
Sept. 20–Jan.—	
Boscawen	12
Bradford	4
Canterbury	3
Chichester	1
Contoocook	9
Franklin	2
Gerrish	5
Halcyon	8
Henniker	16
Hill	2
Newbury	1
Northfield	3
Pittsfield	9
Potter Place	4
Powwow River	1
Suncook	3
Warner	1
West Hopkinton	4
Rockingham County:	
Sept.–Feb.—	
Anderson	2
Andover	2
Derry	3
East Kingston	1

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

NEW HAMPSHIRE—Contd.

	Cars.
Rockingham County—Con.	
Sept.–Feb.—	
Epping	10
Exeter	37
Fremont	1
Greenland	22
Greenland Village	18
Hampton Falls	7
Hedding	1
Newfields	7
Northampton	16
Portsmouth	1
Raymond	3
Seabrook	2
Stratham	19
Windham	5
Strafford County:	
Oct. 4–Dec. 9—	
Barrington	9
Durham	6
Lee	5
Madbury	1
New Durham	1
Rindgemere	6
Rochester	8
West Gonic	13
Sullivan County:	
Sept. 1–Nov. 23—	
Charlestown	20
North Charlestown	2
Northville	3
N. H., State total	529

NEW JERSEY.

Burlington County:	
July 13–Sept. 22—	
Edgewater Park	21
Riverton	11
Camden County:	
July 13–Aug. 15—	
Merchantville	18
Cape May County:	
July–Sept.—	
Anglesea	10
Cumberland County:	
July 2–Sept. 12—	
Bridgeton	12
Greenwich	2
Gloucester County:	
Aug.–June—	
Glassboro	10
Richwood	1
Hudson County:	
Sept. 15–Apr.—	
Jersey City (Warren St.)	1
Weehawken	3
Hunterdon County:	
Sept. 28–Oct. 25—	
Lebanon	1
Raven Rock	7
Mercer County:	
Aug. 1–19—	
Hightstown	9
Middlesex County:	
Aug.—	
Dayton	1
Jamesburg	1
Prospect Plains	2
Monmouth County:	
July 25–Nov. 10—	
Freehold	132
Hazlet	3
Howell	1
Marlboro	7
Middletown	1
Red Bank	131
Shrewsbury	1
Tennent	1
Wickatunk	1

NEW JERSEY—Continued.

	Cars.
Morris County:	
Oct. 6–Dec. 22—	
Chester	2
Ironia	1
Somerset County:	
Sept.—	
Kingston	2
Sussex County:	
Sept.–Jan.—	
Andover	6
Branchville	2
McAfee	2
Sparta	11
Stillwater	4
Sussex	8
Tranquility	1
Vernon	2
Warren County:	
Aug. 30–Dec. 22—	
Allamuchy	5
Belvidere	9
Blairstown	13
Columbia	5
Great Meadows	20
Hackettstown	2
Hainesburg	1
Johnsonburg	8
Vails	6
N. J., State total	498

NEW MEXICO.

Colfax County:	
Oct.–Mar.—	
Cimarron	6
Dona Ana County:	
Sept. 13–Dec. 11—	
Mesilla Park	12
Eddy County:	
Sept. 1–Dec. 15—	
Artesia	12
Otero County:	
Oct.—	
Alamogordo	1
Three Rivers	2
Tularosa	2
Rio Arriba County:	
Oct. 9–Nov. 14—	
Espanola	14
Santa Fe County:	
Oct.—	
Santa Fe	3
N. Mex., State total	52

NEW YORK.

Albany County:	
Sept.–June—	
Albany	266
Altamont	5
Coeymans	2
Feura Bush	37
Guilderland Center	18
Meadowdale	3
New Scotland	12
Ravena	102
Selkirk	11
Slingerlands	6
South Bethlehem	5
Voorheesville	48
Wemple	1
Allegany County:	
Sept.–Jan.—	
Alfred	2
Almond	6
Andover	4
Belfast	3
Canaseraga	8
Cuba	6
Fillmore	2

NEW YORK—Continued.

	Cars.
Allegany County—Contd.	
Sept.–Jan.—	
Friendship	1
Garwoods	1
Rushford	2
Swains	1
Wellsville	5
Broome County:	
Sept.–Jan.—	
Binghamton	8
Conklin	1
Deposit	39
Lisle	6
Nineveh	2
Whitney Point	4
Cattaraugus County:	
Aug. 15–Dec. 31—	
Cattaraugus	22
Conewango	6
Dayton	6
Ellicottville	11
Gowanda	3
Olean	1
Perrysburg	4
Randolph	12
West Valley	8
Cayuga County:	
Sept.–Apr.—	
Atwaters	3
Auburn	11
Cayuga	16
Crockett	5
Genoa	29
Kings Ferry	10
Mapleton	5
Martville	3
Merrifield	1
Moravia	28
North Port Byron	31
Port Byron	3
Sennett	5
Sterling	14
Venice Center	7
Weedsport	4
Chautauqua County:	
Sept.–Feb.—	
Ashville	23
Cherry Creek	5
Clymer	5
Dewittville	2
Dunkirk	3
Falconer Junction	1
Fredonia	5
Irving	2
Jamestown	12
Mayville	3
Portland	3
Prospect	2
Ripley	21
Smith's Mills	4
State Line	2
Watt's Flats	2
Westfield	14
Chemung County:	
Oct.–June—	
Elmira	132
Horseheads	33
Seeley Creek	5
Chenango County:	
Sept. 26–Nov. 21—	
Afton	1
Galena	3
Greene	4
Mount Upton	11
Norwich	2
Oxford	13
Sherburne	16
Sherburne Four Corners	3
Smyrna	13
South New Berlin	7

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

NEW YORK—Continued.

	Cars.
Clinton County:	
Aug. 31–Nov. 30—	
Beekmantown	12
Chazy	10
Mooers Junction	6
Morrisonville	64
Peru	119
Plattsburg	97
Valcour	3
Columbia County:	
July 18–Mar.—	
Ancram	2
Boston Corners	8
Canaan	3
Chatham	21
Chatham Center	16
Cheviot	115
Claverack	128
Copake	6
Craryville	2
East Chatham	12
Elizaville	157
Germantown	290
Ghent	20
Greendale	7
Hillsdale	11
Hudson	186
Hudson Upper	3
Kinderhook	39
Linlithgo	142
Martindale	1
Mellenville	5
Newton Hook	36
Niverville	32
North Chatham	1
Old Chatham	5
Pulvers	3
Silvernails	3
Stockport	62
Stockport Center	1
Stottville	1
Stuyvesant	20
Stuyvesant Falls	62
Valatie	14
Cortland County:	
Oct.–Jan.—	
Blodgett Mills	6
Cincinnatus	2
Cortland	9
Cuyler	5
East Homer	3
Homer	2
Marathon	3
Messengerville	3
Delaware County:	
Oct. 6–Feb.—	
Cook's Falls	3
Davenport Center	1
Delhi	5
Fleischmanns	8
Halcottville	6
Hale's Eddy	5
Hamden	7
Hobart	1
Maywood	9
Merrickville	1
Roxbury	5
Sidney	7
Stamford	1
Walton	7
Youngs	4
Dutchess County:	
Aug. 9–Mar.—	
Bangall	56
Barrytown	32
Beacon	3
Billings	2
Clinton Corners	36
Cokertown	28
Dover Furnace	8
Dover Plains	18
Fishkill	4

NEW YORK—Continued.

	Cars
Dutchess County—Contd.	
Aug. 9–Mar.—	
Holmes	4
Hopewell Junction	2
La Grange	28
Millbrook	33
Millerton	18
Moore's Mills	3
Mount Ross	27
Pawling	2
Pine Plains	6
Pleasant Valley	7
Poughkeepsie	49
Poughquag	19
Red Hook	54
Rhinecliff	8
Salt Point	22
Sharon	6
Shekomeko	32
Staatsburg	3
Stanfordville	10
Stormville	5
Tivoli	38
Wingdale	1
Erie County:	
Aug.–June—	
Angola	4
Buffalo	9
Buffalo Creek	1
Clarence Center	2
Essex County:	
Aug. 28–Dec. 2—	
Crown Point	29
Essex	5
Montcalm Landing	21
Port Henry	3
Port Kent	6
Ticonderoga	28
Westport	1
Whallonsburgh	2
Willsboro	11
Franklin County:	
Sept. 29–Nov.—	
Bangor	1
Constable	1
Genesee County:	
Aug.–May—	
Alabama	2
Batavia	17
Byron	7
Corfu	2
Darien	4
Darien Center	4
East Bethany	12
East Pembroke	1
Elba	1
Le Roy	318
Linden	3
North Bergen	1
North Darien	1
Oakfield	4
Pavilion	10
South Byron	3
Wheatville	1
Greene County:	
Aug. 8–April—	
Athens	27
Catskill	205
Coxsackie	309
New Baltimore	35
West Athens	23
Jefferson County:	
Nov.—	
Antwerp	1
Clayton	2
Livingston County:	
Sept.–May—	
Avon	1
Conesus	9
Craigs	2
Dansville	2
Geneseo	3

NEW YORK—Continued.

	Cars.
Livingston County—Con.	
Sept.–May—	
Greigsville	9
Groveland	1
Hemlock	3
Lakeville	2
Leicester	5
Lima	1
Linwood	3
Livonia	2
Mount Morris	14
South Livonia	5
Springwater	10
Madison County:	
Oct.–Mar.—	
De Ruyter	10
Earlville	7
Erietown	2
Georgetown	2
Hamilton	4
Hubbardsville	4
Lebanon	5
Leonardsville	3
Morrisville	12
Munns	13
New Woodstock	2
North Brookfield	6
Pratts	2
Randallsville	2
Sheds Corners	1
Monroe County:	
Aug.–Apr.—	
Adams Basin	37
Barnard	11
Brighton	349
Brockport	565
Charlotte	18
Churchville	6
Elm Grove	29
Fairport	6
Garbutt	1
Greece	56
Hamlin	35
Henrietta	2
Hilton	181
Honeoye Falls	1
Mendon	1
Morton	34
Mumford	2
Pittsford	18
Rochester	38
Spencerport	113
Uptonville	22
Walker	51
Wayneport	2
Webster	49
Montgomery County:	
Oct.–Jan.—	
Fultonville	4
South Amsterdam	1
New York County:	
Oct.–Apr.—	
New York	64
Niagara County:	
Aug.–June—	
Appleton	67
Barker	278
Burt	101
Cambria	16
Corwins	58
Elberta	65
Gasport	178
Lewiston	106
Lockport	662
Mapleton	1
Middleport	450
Model City	63
Newfane	131
Olcott	24
Ransomville	95
Sanborn	8
Wilson	68
Wrights	36

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

NEW YORK—Continued.

	Cars.
Oneida County:	
Nov.-Jan.—	
Clinton	2
Onondaga County:	
Sept.-Apr.—	
Baldwinsville	3
Halfway	1
Kirkville	1
Lamson	1
Martisco	23
Memphis	5
Onatavia	1
Oran	1
Skaneateles Junction	10
Syracuse	54
Tully	10
Ontario County:	
Sept.-May—	
Aloquin	51
Canandaigua	60
Chapin	1
Clifton Springs	49
Farmington	6
Fishers	10
Geneva	191
Gorham	77
Hall	137
Holcomb	39
Ionia	3
Manchester	11
Mertensia	4
Naples	48
Oaks Corners	47
Orleans	21
Phelps	43
Phelps Junction	10
Seneca Castle	109
Shortsville	12
Stanley	33
Victor	40
West Bloomfield	1
Orange County:	
Aug.-Mar.—	
Cedar Cliff	1
Harriman	2
Little Britain	1
Montgomery	1
Mountainville	4
New Windsor	1
Pine Island	15
Rock Tavern	3
Roseton	2
Walden	3
Warwick	12
Washingtonville	29
Orleans County:	
Aug.-Apr.—	
Albion	414
Ashwood	155
Brice	32
Carlton	91
Eagle Harbor	8
Fancher	23
Holley	53
Kendall	16
Knowlesville	41
Lyndonville	188
Medina	752
Millers	120
Waterport	103
Oswego County:	
Sept.-Mar.—	
Fernwood	3
Fulton	9
Furniss	8
Hannibal	2
Lacona	2
New Haven	22
Oswego	36
Pennellville	1
Scriba	12

NEW YORK—Continued.

	Cars.
Otsego County:	
Oct. 9-Nov. 24—	
Cherry Valley	8
Cooperstown	10
Milford	2
Oneonta	15
Otego	7
Schenevus	1
Unadilla	3
Wells Bridge	5
Putnam County:	
Sept.-Dec.—	
Brewster	3
Carmel	1
Garrison	1
Mahopac	2
Mahopac Falls	40
Patterson	2
Rensselaer County:	
Aug.-Apr.—	
Berlin	7
Brookview	2
Buskirk	8
Castleton	3
East Buskirk	3
East Greenbush	1
East Schodack	9
Hoosick	8
Hoosick Falls	3
Melrose	1
Nassau	5
North Hoosick	5
Petersburg	5
Rensselaer	8
Schodack	51
Troy	25
Valley Falls	14
Van Hoesen	8
West Valley Falls	2
Richmond County:	
Mar. 8—	
St. George Lighterage	1
Rockland County:	
Nov.-Jan.—	
Monsey	1
Pomona	4
St. Lawrence County:	
Sept. 30-Oct.—	
North Lawrence	1
Potsdam	1
Saratoga County:	
July-June—	
Ballston Lake	23
Ballston Spa	203
Elnora	4
Saratoga Springs	4
Schuylerville	2
Waterford	1
Schenectady County:	
Oct.-Jan.—	
Aqueduct	9
Esperance	1
Hoffmans	1
Pattersonville	2
South Schenectady	5
Schoharie County:	
Aug.-May—	
Cobleskill	2
Howes Cave	7
Hyndsville	3
Middleburg	33
Richmondville	10
Schoharie	57
Sharon Springs	6
South Gilboa	1
Schuyler County:	
Oct.-Jan.—	
Alpine	4
Beaver Dams	13
Hector	8
Montour Falls	3
Odessa	13
Reading Center	2
Watkins	9

NEW YORK—Continued.

	Cars.
Seneca County:	
Sept. 14-Dec.—	
Caywood	1
Hayts Corners	3
Interlaken	25
Junius	35
Kendaia	2
Lodi	30
McDougall	3
Ovid	3
Romulus	6
Seneca Falls	46
Sheldrake Springs	38
Waterloo	64
Yale	18
Steuben County:	
Sept.-Mar.—	
Addison	3
Arkport	7
Atlanta	17
Avoca	23
Bath	4
Cameron	1
Cameron Mills	2
Campbell	10
Canisteo	1
Coopers	2
Corning	19
Curtis	1
Freeman	3
Hammondsport	13
Hornell	3
Kanona	11
Painted Post	1
Portway	2
Savona	5
Wallace	23
Wayland	5
Wheeler	5
Suffolk County:	
Sept. 30-Dec. 18—	
Greenport	1
Shelter Island	2
Sullivan County:	
Sept. 21-Nov. 24—	
Cochecton	11
Hankins	19
Liberty	37
Livingston Manor	4
Luzon	11
Monticello	7
Narrowsburg	15
Roscoe	9
Summitville	4
Tioga County:	
Oct. 9-Mar.—	
Apalachin	3
Berkshire	4
Candor	3
Flemingville	1
Newark Valley	6
Nichols	3
North Spencer	2
Owego	2
Richford	8
Spencer	2
West Candor	3
Wilseyville	2
Tompkins County:	
Oct.-Mar.—	
Besemer	3
Brookton	2
Caroline	5
Dryden	17
Etna	6
Groton	18
Ithaca	25
Lake Ridge	9
Newfield	4
North Lansing	30
South Lansing	6
West Danby	9
Willow Creek	3

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

NEW YORK—Continued.

	Cars.
Ulster County:	
July 29–Mar.—	
Clintondale	34
Ellenville	2
Esopus	19
Gardiner	108
Highland	22
Hurley	3
Kerhonkson	8
Kingston	2
Loyd	4
Marlboro	9
Milton	53
Modena	10
Mount Pleasant	3
New Paltz	11
Phoenicia	3
St. Elmo	3
Spring Glen	1
Ulster Park	8
Wallkill	2
West Park	3
Warren County:	
Nov. 24.—	
Lake George	1
Washington County:	
Oct. 5–Feb.—	
Cambridge	9
Dresden	2
Fort Ann	1
Fort Edward	5
Granville	8
Putnam	1
Salem	2
Smith's Basin	5
Wayne County:	
Aug.–Mar.—	
Alton	57
Clyde	252
East Palmyra	2
East Williamson	235
Fruitland	96
Lyons	383
Macedon	5
Marion	20
Newark	13
North Lyons	1
North Newark	7
North Rose	427
Ontario	94
Palmyra	7
Port Gibson	6
Red Creek	190
Savannah	65
Sodus	256
Sodus Center	36
Sodus Point	30
South Palmyra	2
Wallington	12
Walworth	12
Williamson	253
Wolcott	178
Westchester County:	
Sept.–Mar.—	
Baldwin Place	4
Chappaqua	5
Croton Falls	3
Golden's Bridge	3
Granite Springs	1
Katonah	1
Lincolndale	1
Millwood	19
Mount Kisco	4
Ossining	4
Peekskill	1
Pleasantville	8
Purdys	1
Valhalla	2
White Plains	6
Yonkers	1
Yorktown Heights	11

NEW YORK—Continued.

	Cars.
Wyoming County:	
Sept.–Feb.—	
Castile	1
Dale	12
Hardys	2
Pearl Creek	29
Perry	75
Portageville	3
Rock Glen	2
Silver Springs	4
Warsaw	23
Wyoming	58
Yates County:	
Sept.–Apr.—	
Barnes	5
Bellona	96
Benton	58
Bluff Point	34
Branchport	51
Dresden	6
Dundee	72
Earl	21
Glenora	4
Himrod	21
Middlesex	13
Milo	5
Penn Yan	102
Rock Stream	18
Rushville	82
Starkey	35
N. Y., State total	17,579

NORTH CAROLINA.

Alexander County:	
Oct.—	
Taylorsville	5
Ashe County:	
Oct. 10–Dec. 31—	
Bowie	2
Elkland	1
Riverside	4
Buncombe County:	
Sept.–Jan.—	
Asheville	17
Craggy	12
Horning	7
Caldwell County:	
Nov. 15–Dec. 22—	
Lenoir	6
Cleveland County:	
Oct. 12—	
Willis	1
Haywood County:	
Aug. 1–Feb.—	
Canton	23
Clyde	10
Lake Junaluska	1
Waynesville	82
Woodrow	76
Henderson County:	
Aug. 19–Dec. 13—	
Fletcher	3
Hendersonville	35
Jackson County:	
Aug. 23–Nov. 23—	
Addie	9
Dillsboro	6
Mitchell County:	
Nov. 15–Dec. 20—	
Toecane	3
Polk County:	
Sept. 25–Oct. 17—	
Saluda	2
Surry County:	
Aug. 8–Oct. 25—	
Mt. Airy	142

NORTH CAROLINA—Contd.

	Cars.
Yancey County:	
Sept. 20–Dec. 23—	
Burnsville	14
Pensacola	5
N. C., State total	466

NORTH DAKOTA.

Nelson County:	
Oct. 21—	
Whitman	1
Richland County:	
Oct. 24—	
Farmington	2
Stutsman County:	
Oct.—	
Kensal	2
Wells County:	
Oct.—	
Cathay	1
N. Dak., State total	6

OHIO.

Ashtabula County:	
Oct. 1—	
Geneva	1
Athens County:	
Sept.–Mar.—	
Amesville	9
Athens	4
Coolville	38
Guysville	23
New Marshfield	4
Stewart	14
Torch Hill	27
Trimble	1
Belmont County:	
Oct. 9–Nov. 10—	
Belmont	3
Powhatan	6
Carroll County:	
Aug.–Oct.—	
Augusta	6
Clermont County:	
Oct. 12–17—	
Bethel	3
Columbiana County:	
Aug.–Apr.—	
Columbiana	46
East Liverpool	2
East Palestine	1
Kensington	3
Leetonia	9
Lisbon	38
Negley	3
New Waterford	78
Salem	19
Washingtonville	3
Coshocton County:	
Oct.–Jan.—	
Chili	1
Mohawk	1
Warsaw Junction	3
Cuyahoga County:	
July–June—	
Cleveland	6
Defiance County:	
Oct.—	
Defiance	11
Delaware County:	
Oct.–June—	
Delaware	14
Lewis Center	4

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

OHIO—Continued.

	Cars.
Erie County:	
Oct.-Mar.—	
Berlin Heights	10
Birmingham	34
Ceylon	1
Florence	1
Huron	1
Sandusky	15
Vermillion	64
Fairfield County:	
Aug. 18-Oct. 13—	
Bremen	1
Lancaster	3
Pleasantville	1
Stoutsville	1
Fayette County—	
Nov.-Mar.—	
Washington C. H	3
Franklin County:	
Oct.-Jan.—	
Columbus	140
Gallia County:	
Aug.-Jan.—	
Alice	3
Bidwell	4
Gallia	11
Gallipolis	245
Kerrs	1
Geauga County:	
Oct.-Jan.—	
Chardon	1
East Claridon	4
Guernsey County:	
Oct. 6-Dec. 8—	
Cambridge	2
Quaker City	24
Senecaville	2
Hamilton County:	
Aug.-May—	
Brighton	8
Cincinnati	25
Harrison County:	
Sept. 9-Oct. 24—	
Freeport	6
Huron County:	
Sept.-Jan.—	
Bellevue	3
Norwalk	6
Wakeman	26
Jackson County:	
Aug. 21—Oct. 20—	
Jackson	3
Oak Hill	1
Jefferson County:	
Dec.-Apr.—	
Empire	12
Lake County:	
Oct.-Jan. 24—	
Painesville	3
Unionville	1
Lawrence County:	
July 20-Dec. 15—	
Coal Grove	24
Ironton	61
Licking County:	
Oct. 5-24—	
Hanover	4
Newark	2
St. Louisville	1
Logan County:	
Nov. 2—	
Bellefontaine	1
Lorain County:	
Oct.-May—	
Amherst	8
Elyria	19
Kipton	2
Lorain	1
Lucas County:	
Oct. 10—	
Maumee	1

OHIO—Continued.

	Cars.
Mahoning County:	
Oct.-Mar.—	
Calla	1
Garfield	19
Snodes	2
Meigs County:	
Oct. 1-Dec. 31.—	
Carpenter	2
Dexter	10
Langsville	17
Rutland	10
Montgomery County:	
Nov. 14-17—	
Dayton	2
Muskingum County:	
Nov.-Apr.—	
Trinway	12
Zanesville	33
Noble County:	
Nov. 13—	
South Olive	1
Ottawa County:	
Aug.-Nov.—	
Danbury	1
Gypsum	7
La Carne	3
Oak Harbor	8
Port Clinton	10
Perry County:	
Oct. 26—	
New Lexington	1
Pike County:	
Oct. 12-Nov. 21—	
Givens	4
Omega	2
Waverly	3
Portage County:	
Oct.-Mar.—	
Atwater	5
Freedom	2
Garrettsville	9
Hiram	2
Mahoning	3
Mantua	2
Ravenna	7
Rootstown	10
Putnam County:	
Oct. 13—	
Leipsic	1
Richland County:	
Oct. 16-31—	
Bellville	3
Ross County:	
Aug. 1-Jan.—	
Bainbridge	8
Chillicothe	28
Kingston	4
Musselman	23
Roxabel	2
Sandusky County:	
Sept. 14-Nov. 6—	
Clyde	38
Vickery	7
Stark County:	
Oct.—	
Minerva	1
Summit County:	
Oct. 13-Nov. 21—	
Hudson	3
Trumbull County:	
Oct. 24-Nov.—	
Braceville	1
Kinsman	1
Phalanx	2
Tuscarawas County:	
Dec.-Jan.—	
Bolivar	1
Port Washington	1

OHIO—Continued.

	Cars.
Washington County:	
Aug. 5-June—	
Belpre	20
Constitution	2
Elba	2
Fleming	20
Little Hocking	52
Lowell	29
Marietta	35
Porterfield	9
Relief	13
Swifts	4
Vincent	8
Wayne County:	
Oct. 17-Nov. 4—	
Smithville	5
Wooster	1
Wyandot County:	
Oct.—	
Wharton	6
Ohio, State total	1,689

OKLAHOMA.

Adair County:	
Sept. 27-Nov. 10—	
Stillwell	2
Westville	13
Seminole County:	
Oct.—	
Konawa	2
Okla., State total	17

OREGON.

Baker County:	
Oct. 4-Nov. 1—	
Huntington	3
Robinett	1
Benton County:	
Oct. 21-Nov. 11—	
Corvallis	2
Corvallis Junction	1
Clackamas County:	
Oct. 20-Dec. 2—	
Clackamas	1
Oswego	1
Crook County:	
Dec. 21—	
Redmond	1
Douglas County:	
Sept.-Feb.—	
Dillard	12
Drain	4
Riddle	7
Roseburg	42
Sutherlin	1
Wilbur	1
Yoncalla	4
Hood River County:	
Aug.-May—	
Hood River	1,982
Odell	35
Van Horn	29
Jackson County:	
Sept.-Apr.—	
Ashland	29
Central Point	7
Eagle Point	6
Gold Hill	17
Medford	341
Phoenix	23
Rogue River	3
Talent	31
Josephine County:	
Sept. 5-Mar.—	
Grants Pass	73
Merlin	1
Wilderville	1

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

OREGON—Continued.

	Cars.
Klamath County:	
Jan. 11—	
Klamath Falls	1
Lane County:	
Sept. 30–Dec. 15—	
Cottage Grove	2
Creswell	10
Eugene	11
Irving	1
Junction City	3
Linn County:	
Nov. 3–Dec. 22—	
Albany	1
Brownsville	1
Lebanon	2
Tangent	5
West Scio	2
Malheur County:	
Oct.–Feb.—	
Brogan	4
Nyssa	1
Ontario	1
Marion County:	
Oct.–Mar.—	
Brooks	2
Chemawa	5
Fair Grounds	1
Hubbard	1
Salem	14
Woodburn	2
Morrow County:	
Oct. 14–Nov. 22—	
Irrigon	2
Multnomah County:	
Aug.–Apr.—	
Albina	2
East Portland	9
Fairview	2
Portland	50
Polk County:	
Oct. 13–Dec. 19—	
Dallas	7
Monmouth	2
Umatilla County:	
July–Mar.—	
Freewater	1
Hermiston	10
Milton	206
Stanfield	2
Umatilla	1
Union County:	
Sept.–Mar.—	
Cove	26
Elgin	8
Imbler	91
La Grande	26
Union	34
Union Junction	5
Wasco County:	
Oct. 4–Mar.—	
Dufur	5
Mosier	56
The Dalles	13
Washington County:	
Sept.–Apr.—	
Banks	2
Dilley	5
North Plains	1
Yamhill County:	
Oct. 25–Dec. 23—	
McMinnville	1
Newberg	2
Oreg., State total	3,298

PENNSYLVANIA.

	Cars.
Adams County:	
Aug. 1–Dec. 20—	
Bendersville	96
Biglerville	576
Fairfield	12
Guernsey	127

PENNSYLVANIA—Contd.

	Cars.
Adams County—Contd.	
Aug. 1–Dec. 20—	
Guldens	6
Jack's Mountain	7
McKnightstown	30
New Oxford	4
Orrtanna	112
Allegheny County:	
Oct.–June—	
Allegheny	2
Pittsburgh	2
Armstrong County:	
Oct. 2–Dec. 1—	
Craigsville	2
Putneyville	1
Bedford County:	
Aug.–Mar.—	
Bedford	116
Buffalo Mills	20
Cessna	9
Fishertown	29
Fossilville	7
Hyndman	2
Imler	11
Manns Choice	26
Queen	11
Berks County:	
Sept. 25–Nov. 1—	
Boyertown	9
Blair County:	
July 29–Nov. 17—	
Curry	24
Duncansville	1
East Freedom	1
Martinsburg	21
Ore Hill	2
Williamsburg	3
Bradford County:	
Sept. 13–Dec. 21—	
Alba	4
Canton	17
Columbia Cross Roads	2
Cowley	2
Gillett	4
Grover	4
Milan	2
New Albany	42
Standing Stone	2
Towanda	3
Troy	9
Wilawana	1
Wyalusing	15
Wysox	4
Center County:	
Sept.–Feb.—	
Bellefonte	8
Centre Hall	3
Coburn	1
Hecla Park	6
Oak Hall	3
Port Matilda	4
Rising Springs	11
Unionville	3
Clarion County:	
Aug.–Oct.—	
Mayport	8
Clearfield County:	
Dec.—	
Kerrmoor	3
Clinton County:	
Sept. 19–Nov. 15—	
Lamar	11
Mill Hall	3
Salona	5
Columbia County:	
Oct.–Jan.—	
Benton	52
Berwick	1
Crawford County:	
Oct.–Mar.—	
Spartansburg	2
Titusville	1

PENNSYLVANIA—Contd.

	Cars.
Cumberland County:	
Sept.–Jan.—	
Boiling Springs	15
Bowmansdale	22
Gardners	46
Gettysburg Junction	348
Greason	9
Greythorne	1
Hay's Grove	8
Hunter's Run	19
Lees Cross Roads	4
Longsdorf	35
Newville	8
Shippensburg	7
Starners	32
Elk County:	
Apr. 22—	
Johnsonburg	1
Erie County:	
Sept.–Jan.—	
Corry	1
Girard	1
Mill Village	3
North East	16
Springfield	2
Union City	2
Waterford	4
Fayette County:	
Oct. 12–15—	
Connellsville	3
Franklin County:	
July–May—	
Chambersburg	166
Conboy	18
East Fayettville	55
Fayetteville	51
Fort Loudon	4
Geiser	7
Greencastle	74
Lehmasters	41
Marion	29
Mason Dixon	14
Mercersburg	1
Midvale	71
Mont Alto	127
Quincy	84
Richmond	29
Scotland	48
Waynecastle	14
Waynesboro	62
Huntingdon County:	
Oct. 3–Dec. 7—	
Pennsylvania Furnace	3
Union Furnace	1
Indiana County:	
Oct. 26—	
Cherry Tree	2
Jefferson County:	
Nov. 11—	
Big Run	1
Juniata County:	
Oct. 24–Nov. 11—	
Honey Grove	1
Thompsontown	1
Lackawanna County:	
Dec.–Feb.—	
Carbondale	3
La Plume	5
Moscow	2
Scranton	4
Lancaster County:	
Oct.–May—	
Elizabethtown	1
Lancaster	3
Lawrence County:	
Oct. 13–Mar.—	
New Castle	2
Newport	1
New Wilmington	2
Pulaski	1
Lehigh County:	
Oct. 27–Nov. 3—	
Hosensack	3

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES Continued.

PENNSYLVANIA—Contd.

	Cars.
Luzerne County:	
Dec. 8–29—	
Dallas	2
Shicksbinny	6
Lycoming County:	
Aug. 31–Dec. 30—	
Bodines	23
Halls	1
Jersey Shore	1
Larry's Creek	1
Roaring Branch	7
Trout Run	6
Williamsport	1
Mercer County:	
Oct.–Nov.—	
Clarks Mills	1
Fredonia	4
Mercer	1
Sandy Lake	4
West Middlesex	1
Mifflin County:	
Oct. 12–Nov. 2—	
Belleville	10
Monroe County:	
Aug. 15–Nov. 10—	
Analomink	1
Cresco	7
Saylorsburg	3
Tobyhanna	2
Montour County:	
Nov. 11–21—	
Mooresburg	2
Northampton County:	
Oct. 1–17—	
Danielsville	1
Portland	2
Philadelphia County:	
Nov.–June—	
Philadelphia	158
Shackamaxon	2
Pike County:	
Oct. 7—	
Mast Hope	1
Potter County:	
Oct.–Feb.—	
Coudersport	4
Galeton	6
Genesee	5
Harrison Valley	1
Millport	1
Mills	7
Oswayo	2
Ulysses	2
Schuylkill County:	
Oct. 24–Nov. 1—	
Good Spring	3
Snyder County:	
Oct. 21–Nov. 10—	
Beaver Springs	1
Selinsgrove	4
Somerset County:	
Oct. 9–Dec. 15—	
Berlin	9
Boswell	11
Friedens	10
Glencoe	1
Markleton	1
Stoyestown	2
West Salisbury	20
Sullivan County:	
Sept.–Mar.—	
Dushore	21
Susquehanna County:	
Sept. 10–Mar.—	
Alford	12
Foster	28
Kingsley	25
Montrose	14
New Milford	54
South Montrose	17
Springville	8
Starrucca	4
Thompson	3

PENNSYLVANIA—Contd.

	Cars.
Tioga County:	
Aug. 15–Feb.—	
Ansonia	5
Arnot	2
Gaines Junction	9
Hoytville	11
Knoxville	8
Lawrenceville	2
Middlebury	10
Millerton	9
Nelson	1
Potter Brook	12
Sabinsville	8
Tioga	13
Tioga Junction	4
Trowbridge	3
Wellsboro	20
Wellsboro Junction	10
Westfield	8
Union County:	
Oct. 19—	
Vicksburg	1
Venango County:	
Oct.—	
Raymilton	1
Warren County:	
Nov. 7—	
Lottsville	1
Wayne County:	
Oct.–Feb.—	
Gouldsboro	2
Gravity	4
Honesdale	34
Lake Ariel	15
Lakewood	7
Maplewood	1
Poyntelle	1
Starlight	1
Waymart	1
Wyoming County:	
Oct. 15–Dec. 31—	
Laceyville	6
Meshoppen	12
Noxen	4
Tunkhannock	8
Vosburg	7
York County:	
Oct. 11–Mar.—	
Brogueville	1
Dillsburg	3
Emigsville	2
Felton	5
Hanover	1
Hanover Junction	1
Laurel	2
New Park	16
Sheffer	10
Stewartstown	25
Turnpike	15
Wiley	39
York	1
Pa., State total	3,909

RHODE ISLAND.

	Cars.
Providence County:	
Aug.–May—	
Providence	12
R. I., State total	12

SOUTH DAKOTA.

	Cars.
Brookings County:	
Sept.–Apr.—	
Elkton	7
Brown County:	
Sept.–Jan.—	
Aberdeen	6
Columbia	1

SOUTH DAKOTA—Contd.

	Cars.
Clay County:	
Sept. 11—	
Vermillion	1
Fall River County:	
Sept. 1–Oct. 15	
Hot Springs	2
Hand County:	
Sept.—	
Ree Heights	2
Hanson County:	
Sept.—	
Fulton	2
Minnehaha County:	
Sept.–Mar.—	
Sioux Falls	7
Union County:	
Aug.—	
Beresford	3
Elk Point	2
S. Dak., State total	33

TENNESSEE.

	Cars.
Davidson County:	
July–June—	
Nashville	15
Gibson County:	
Oct.—	
Rutherford	1
Johnson County:	
Aug. 1–Oct. 1—	
Shouns	6
Lincoln County:	
July 15—	
Fayetteville	1
Marshall County:	
June 15–20—	
Talley	4
Maury County:	
June 19–July 17—	
Campbells	1
Carters Creek	1
Columbia	7
Shelby County:	
June–May—	
Memphis	12
Sumner County:	
June 24–July 20—	
Avondale	1
Portland	5
Williamson County:	
June 14–Sept. 28—	
Ewells	8
Franklin	15
Thompsons	2
Wilson County:	
June 23–Sept. 30—	
Leeville	3
Tenn., State total	82

TEXAS.

	Cars.
Callahan County:	
July 22–Oct. 1—	
Clyde	10
Cross Plains	2
Comanche County:	
Aug. 1–Sept. 30—	
Comanche	3
De Leon	5
Sipe Springs	1
Dallas County:	
July–May—	
Dallas	14
Eastland County:	
Aug.–Oct.—	
Carbon	1
Gorman	25
Erath County:	
Aug. 4–Oct. 1—	
Dublin	14
Stephenville	2

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

TEXAS—Continued.

	Cars.
Lamar County:	
Sept.—	
Paris	10
Tarrant County:	
May 8—	
Fort Worth	1
Wise County:	
Oct. 12—	
Decatur	1
Tex., State total	89

UTAH.

Boxelder County:	
Oct.–Apr.—	
Brigham	2
Dewey	2
Honeyville	1
Tremonton	1
Cache County:	
Jan. 29—	
Logan	1
Carbon County:	
Oct.—	
Price	8
Grand County:	
Sept. 3–Nov. 8—	
Thompsons	4
Salt Lake County:	
July–Mar.—	
Salt Lake City	11
Utah County:	
Oct.—	
Provo	2
Weber County:	
Oct.–Mar.—	
Ogden	3
Utah, State total	35

VERMONT.

Addison County:	
Sept. 12–Nov. 27—	
Ferrisburg	3
Middleburg	62
Orwell	4
Salisbury	1
Shoreham	2
Vergennes	23
Whiting	2
Bennington County:	
Nov. 2–Jan.—	
Bennington	3
East Dorset	3
North Bennington	7
North Pownal	3
Shaftsbury	1
Chittenden County:	
Sept. 1–Dec. 23—	
Burlington	4
Charlotte	45
Jonesville	1
Shelburne	30
Shelburne Harbor	1
Underhill	5
Williston	2
Franklin County:	
Oct. 2–Nov. 7—	
East Highgate	20
Swanton	1
Grand Isle County:	
Sept.–June—	
Grand Isle	24
Isle LaMotte	94
Isle LaMotte Station	5
North Hero	6
South Hero	33
Lamoille County:	
Oct. 6—	
Cambridge	1

VERMONT—Continued.

	Cars.
Orange County:	
Oct. 4–Nov.—	
Bradford	4
Ely	1
Fairlee	1
Randolph	3
Thetford	1
Rutland County:	
Oct. 4–Feb.—	
Clarendon	3
Danby	12
Rutland	17
South Wallingford	3
West Pawlet	2
Windham County:	
Sept. 23–Dec. 2—	
Bellows Falls	2
Brattleboro	10
Dummerston	1
Jamaica	3
Newfane	1
Putney	7
South Vernon	1
Wardsboro	7
West Townshend	4
Windsor County:	
Sept. 20–Nov. 24—	
Bethel	4
Chester	25
Proctorsville	5
South Royalton	2
Springfield	17
West Hartford	6
Woodstock	3
Vt., State total	531

VIRGINIA.

Albemarle County:	
June–Jan.—	
Alberene	1
Arrowhead	26
Campbell	9
Charlottesville	195
Covesville	136
Crozet	115
Greenwood	46
Ivy	21
Mechum's River	11
North Garden	8
Red Hill	7
Shadwell	2
Alleghany County:	
Dec. 15—	
Alleghany	1
Amherst County:	
Sept. 20–Dec. 20—	
Amherst	29
Lowesville	92
Winesap	2
Appomattox County:	
Aug. 15–Oct. 1—	
Appomattox	1
Augusta County:	
July–Jan.—	
Basic	35
Cave Station	10
Christian	81
Crimora	17
Fisherville	81
Fort Defiance	11
Greenville	29
Harriston	5
Hot Springs	35
Lyndhurst	17
Mint Springs	29
Mount Sidney	6
Spottswood	3
Staunton	544
Stuart's Draft	9
Swoope	21
Waynesboro	49
Weyer's Cave	9

VIRGINIA—Continued.

	Cars.
Bath County:	
Nov. 30—	
Millboro	1
Bedford County:	
Sept. 7–Dec. 15—	
Bedford	15
Big Island	43
Coleman	18
Forest	3
Pearch	2
Thaxton	37
Botetourt County:	
Sept. 13–Nov. 3—	
Buchanan	1
Cloverdale	298
Lithia	2
Nace	5
Springwood	2
Troutville	53
Buckingham County:	
Oct. 9—	
Johnson	1
Campbell County:	
Sept.–Apr.—	
Lawyers	3
Lynchburg	29
Rustburg	1
Taber	1
Clarke County:	
July 14–Mar.—	
Berryville	233
Boyce	47
White Post	53
Craig County:	
Oct. 27—	
New Castle	1
Culpeper County:	
Aug. 16–Nov. 20—	
Culpeper	98
Fauquier County:	
Sept. 8–Nov. 14—	
Broad Run	1
Markham	59
Marshall	4
Franklin County:	
Aug. 11–Dec. 29—	
Boones Mill	116
Ferrum	8
Wirtz	4
Frederick County:	
July–June—	
Clearbrook	65
Kernstown	132
Middletown	93
Stephens City	280
Winchester	2,124
Giles County:	
Oct. 1–Dec. 10—	
Narrows	12
Rich Creek	1
Ripplemead	6
Grayson County:	
Oct. 15–Nov. 1—	
Fries	2
Galax	1
Henrico County:	
June–May—	
Richmond	127
Loudoun County:	
Sept. 5–Nov. 30—	
Bluemont	15
Leesburg	30
Paeonian Springs	1
Purcellville	27
Round Hill	18
Montgomery County:	
Sept. 4–Dec. 31—	
Blacksburg	14
Christiansburg	83
East Radford	6
Shawsville	46

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

VIRGINIA—Continued.

	Cars.
Nelson County:	
Sept. 1–Dec. 15—	
Afton	167
Arrington	100
Elma	2
Faber	14
Massie Mill	49
Rockfish	2
Shipman	72
Tye River	2
Norfolk County:	
June 23–Nov. 16—	
Fentress	1
Norfolk	5
Port Norfolk	1
Northampton County:	
Oct. 5–20—	
Cobham	5
Orange County:	
Sept. 28–Nov. 30—	
Barboursville	20
Gordonsville	4
Orange	9
Page County:	
Aug.–Apr.—	
Elgin	68
Luray	27
Rileyville	13
Shenandoah	3
Stanley	14
Patrick County:	
Aug. 7–Dec. 15—	
Patrick Springs	7
Stuart	201
Pulaski County:	
Aug.–Dec. 26—	
Draper	7
Dublin	40
Pulaski	15
Roanoke County:	
Aug.–July—	
Bonsack	6
East Roanoke	153
Hollins	18
Roanoke	115
Salem	73
Starkey	287
Rockbridge County:	
Aug. 15–Dec. 1—	
Buena Vista	1
East Lexington	1
Fairfield	25
Goshen	1
Lexington	4
Raphine	7
Rockingham County:	
July 1–Mar.—	
Broadway	67
Daphna	5
Elkton	22
Grottoes	4
Harrisonburg	153
Linville	76
Mount Crawford	5
Pleasant Valley	36
Timberville	36
Shenandoah County:	
July 29–Dec. 30—	
Capon Road	14
Edinburg	25
Fishers Hill	60
Maurertown	20
Mount Jackson	282
New Market	2
Strasburg	10
Toms Brook	66
Woodstock	118
Smyth County:	
July 22–Oct. 23—	
Chilhowie	12
Groseclose	5
Marion	3
Seven Mile Ford	2

VIRGINIA—Continued.

	Cars.
Spotsylvania County:	
Sept. 14–Oct. 14—	
Fredericksburg	6
Tazewell County:	
Nov. 10—	
Tiptop	1
Warren County:	
July 19–Dec. 31—	
Ashby	26
Bentonville	10
Front Royal	432
Limeton	5
Linden	139
Riverton	2
Washington County:	
Oct. 5–15—	
Creek Junction	1
Konnarock	1
Wythe County:	
July 14–Nov. 23—	
Barren Springs	1
Crockett	73
Rural Retreat	50
Speedwell	5
Wytheville	28
June–Aug. 22—	
Piankatank River landings	2
July–Aug. 10:	
Potomac River landings	1
June–Aug. 21—	
Rappahannock River landings	3
Va., State total	9,263

WASHINGTON.

Benton County:	
July–May—	
Benton	7
Hanford	32
Kennewick	204
North Prosser	10
Prosser	71
Richland	1
White Bluffs	11
Chelan County:	
July–June—	
Cashmere	1,434
Chelan	198
Dryden	31
Entiat	670
Leavenworth	35
Monitor	1
Peshastin	5
Wenatchee	2,892
Columbia County:	
Aug. 24–Dec. 22—	
Dayton	65
Starbuck	2
Douglas County:	
Sept. 11–Dec. 2—	
Columbia River	10
Ferry County:	
Nov. 21—	
Danville	1
Grant County:	
Aug.–June—	
Coulee City	7
Ephrata	4
Hartline	1
Neppel	30
Quincy	7
Trinidad	18
King County:	
Nov.–Apr.—	
Humphreys	1
Seattle	4

WASHINGTON—Continued.

	Cars.
Kittitas County:	
Oct. 31–Mar.—	
Ellensburg	16
Kittitas	2
Thorp	3
Thrall	20
Wymer	1
Lewis County:	
Nov. 24—	
Chehalis	1
Lincoln County:	
Aug. 4.–Apr.—	
Creston	85
Davenport	9
Okanogan County:	
Aug.–Jan.—	
Brewster	257
Okanogan	71
Omak	261
Pateros	13
Tonasket	5
Skamania County:	
Oct. 9–Nov. 16—	
Cook	7
Spokane County:	
Aug.–June—	
Cheney	1
Dean	33
Dishman	53
Fairfield	6
Greenacre	1
Irvin	52
Kiesling	1
Latah	4
Manito	3
Mica	9
Millwood	11
Opportunity	2
Otis Orchards	248
Rockford	3
Spokane	307
Yardley	129
Stevens County:	
Sept.–June—	
Loon Lake	1
Marcus	1
Meyers Falls	83
Northport	2
Thurston County:	
Nov. 10–18—	
St. Clair	1
Stone	1
Walla Walla County:	
Aug.–July—	
Prescott	5
Touchet	29
Waitsburg	66
Walker	12
Walla Walla	259
Wallula	39
Whitman County:	
Sept. 2–Mar.—	
Albion	1
Bishop	1
Colfax	5
Farmington	14
Garfield	8
Hooper	17
La Crosse	3
Oakesdale	1
Palouse	2
Pullman	6
Ridpath	1
Yakima County:	
July–June—	
Ahtanum	12
Baird	3
Clark	69
Clift	10
Congdon	49
Dalton	2
Exchange	107
Fairview	2

DECIDUOUS FRUITS—Continued.

Table 1.—APPLES—Continued.

WASHINGTON—Continued.

	Cars.
Yakima County—Contd.	
July-June—	
Fruitvale	7
Gore	5
Grandview	79
Granger	99
Hardwood	2
Mabton	5
Morgans	1
North Yakima	3,396
Orchard	54
Outlook	9
Parker	8
Piedmont	1
Selah	668
Shannon	54
Stone	7
Stewart	3
Sunnyside	17
Taylor	11
Teplitz	5
Toppenish	198
Van de Water	14
Wapato	48
Wiley City	16
Wright	64
Zillah	1,024
Wash., State total	13,980

WEST VIRGINIA.

	Cars.
Barbour County:	
Nov. 14–Dec. 31—	
Belington	3
Berkeley County:	
July 15–May—	
Bedington	21
Bunker Hill	202
Falling Waters	16
Inwood	600
Martinsburg	461
North Mountain	3
Ridgeway	302
Tablers	472
Cabell County:	
Aug. 26–Feb.—	
Blue Sulphur Springs	4
Cox Landing	41
Guyandotte	56
Huntington	51
Milton	1
Fayette County:	
Oct. 5–31—	
Oak Hill	3
Greenbrier County:	
Oct. 19–Nov. 18—	
Fort Springs	20
Ronceverte	3
Hampshire County:	
Aug. 12–Nov. 15—	
French	25
Romney	186
Springfield	38
Hancock County:	
Sept.–June—	
Chester	14
New Cumberland	162
Hardy County:	
Sept. 14–Oct. 7—	
McNeil	7
Jackson County:	
Sept.—	
Millwood	10
Ravenswood	7
Ripley	2

WEST VIRGINIA—Continued.

	Cars.
Jefferson County:	
Aug.–June—	
Charles Town	437
Duffield	20
Engle	5
Halltown	6
Kearneysville	342
Rippon	88
Shenandoah Junction	39
Shepherdstown	118
Summit Point	42
Lewis County:	
Sept. 27–Oct. 1—	
Janelew	2
Marshall County:	
Sept.—	
Woodlands	4
Mason County:	
July 26–Dec. 16—	
Apple Grove	2
Arbuckle	4
Gallipolis Ferry	2
Glenwood	3
Graham	2
Letart	4
Point Pleasant	18
Mineral County:	
Sept. 12–Oct. 12—	
Burlington	4
Keyser	35
Monroe County:	
Nov. 10–25—	
Alderson	2
Morgan County:	
July 10–Apr. —	
Berkeley Springs	163
Cherry Run	16
Hancock	7
Paw Paw	94
Pleasants County:	
Aug. 9–Nov. 18—	
Belmont	23
Raven Rock	20
Pocahontas County:	
Nov. 15—	
Marlinton	2
Putnam County:	
Sept. 13–Nov. 4—	
Hurricane	5
Raymond City	2
Randolph County:	
Oct. 25—	
Beverly	1
Summers County:	
Dec. 4—	
Pence Springs	1
Tyler County:	
Oct. 21–Dec. 7—	
Bens Run	10
Friendly	10
Wayne County:	
Oct.—	
Kenova	3
Wetzel County:	
Sept. 30–Nov. 1—	
New Martinsville	8
Wood County:	
Oct.–Jan.—	
Belleville	24
Parkersburg	97
Waverly	12
Williamstown	2
W. Va., State total	4,389

WISCONSIN.

	Cars.
Ashland County:	
Oct.—	
Butternut	2
Barron County:	
Oct.—	
Barron	1
Door County:	
Sept.–Nov.—	
Sturgeon Bay	10
Eau Claire County:	
Oct.—	
Eau Claire	2
Fond du Lac County:	
Nov. 9—	
Ripon	1
Green Lake County:	
Nov.—	
Berlin	1
Kewaunee County:	
Oct. 24—	
Casco	1
Marinette County:	
Aug. 17—	
Marinette	1
Marquette County:	
Sept. 10—	
Endeavor	1
Packwankee	1
Milwaukee County:	
Oct.–June—	
Milwaukee	57
Outagamie County:	
Sept. 1–Oct. 12—	
Medina	2
Richland County:	
Sept. 15–Nov. 16—	
Richland Center	7
Twin Bluffs	5
Rock County:	
Dec. 4—	
Janesville	1
Sauk County:	
Sept. 14–Nov. 9—	
Baraboo	7
Reedsburg	2
Sawyer County:	
Oct. 5—	
Hayward	1
Vernon County:	
Sept. 26—	
Coon Valley	1
Washburn County:	
June 1—	
Spooner	1
Waupaca County:	
Aug.—	
Weyauwega	1
Winnebago County:	
Aug. 25–Nov. 4—	
Omro	2
Oshkosh	2
Wis., State total	110

WYOMING.

	Cars.
Weston County:	
Oct.—	
Newcastle	1
Wyo., State total	1

DECIDUOUS FRUITS—Continued.

Table 2.—APRICOTS.

CALIFORNIA.

	Cars.
Contra Costa County:	
June 9–25—	
Concord	4
Oakley	20
Fresno County:	
June 9–July 2—	
Parlier	28
Imperial County:	
May 20–30—	
El Centro	5
Los Angeles County:	
June 6–24—	
Glendale	1
Los Angeles	2
Riverside County:	
June 3–17—	
Banning	8

CALIFORNIA—Continued.

	Cars.
San Bernardino County:	
June 9–20—	
Redlands Junction	4
Santa Barbara County:	
June 8—	
Santa Maria	4
Solano County:	
June—	
Fairfield	1
Ventura County:	
June 8–13—	
Piru	7
Cal., State total	84

WASHINGTON.

	Cars.
Chelan County:	
July 15–Aug. 8—	
Monitor	6
Wenatchee	100
Okanogan County:	
July 29–31—	
Omak	5
Wash., State total	111

Table 3.—CHERRIES.

CALIFORNIA.

	Cars.
Placer County:	
May 2–20—	
Loomis	1
Newcastle	3
Penryn	4
Sacramento County:	
Apr. 4–May 10—	
Sacramento	9
San Joaquin County:	
May 23—	
Stockton	1
Santa Clara County:	
May 14—	
San Jose	1
Solano County:	
Apr. 25–May 21—	
Cordelia	19
Vacaville	11
Sonoma County:	
May 26–June 13—	
Sebastopol	2
Cal., State total	51

COLORADO.

	Cars.
Denver County:	
July 13–22—	
Denver	3
Colo., State total	3

IDAHO.

	Cars.
Nez Perce County:	
July 1–10:	
Lewiston	64
Idaho, State total	64

IOWA.

	Cars.
Marion County:	
June 23–28—	
Knoxville	3
Iowa, State total	3

MARYLAND.

	Cars.
June:	
Choptank River landings	2
Md., State total	2

MICHIGAN.

	Cars.
Benzie County:	
July 15–Aug. 8—	
Frankfort	2
Berrien County:	
July 5—	
Benton Harbor	1
Grand Traverse County:	
July 10–Aug. 26—	
Old Mission	3
Traverse City	195
Manistee County:	
July 15–Aug. 14—	
Manistee	2
Onekama	6
Mason County:	
July 5–Aug. 16—	
Ludington	29
Oceana County:	
July 18–Aug. 24—	
Hart	3
Mears	1
Shelby	30
Ottawa County:	
July 12—	
Grand Haven	1
Van Buren County:	
June 27–Aug. 12—	
Paw Paw	11
South Haven	31
Mich., State total	315

MINNESOTA.

	Cars.
Hennepin County:	
June—	
Minneapolis	1
Minn., State total	1

MONTANA.

	Cars.
Ravalli County:	
June—	
Hamilton	1
Mont., State total	1

NEW JERSEY.

	Cars.
Burlington County:	
June 15–July 5—	
Beverly	8
Edgewater Park	6
Gloucester County:	
June 26–30—	
Richwood	2
N. J., State total	16

NEW YORK.

	Cars.
Columbia County:	
June 23–Aug. 3—	
Germantown	61
Greendale	9
Hudson	33
Linlithgo	11
North Germantown	28
New York County:	
July 20–Nov. 21—	
New York	2
Ontario County:	
July 8–24—	
Geneva	18
Orange County:	
July 10–13—	
Roseton	1
Ulster County:	
July 13—	
Milton	1
N. Y., State total	164

OHIO.

	Cars.
Huron County:	
June 28–July 28—	
Bellevue	12
Miami County:	
June 28–July 5—	
Troy	3
Ohio, State total	15

OREGON.

	Cars.
Hood River County:	
July 12–19—	
Hood River	4
Umatilla County:	
June 19–July 15—	
Freewater	4
Milton	15
Union County:	
July 23–Aug. 6—	
Cove	35
Wasco County:	
July 6–10—	
The Dalles	3
Oreg., State total	61

PENNSYLVANIA.

	Cars.
Erie County:	
July 12—	
North East	1
Pa., State total	1

DECIDUOUS FRUITS—Continued.

Table 3.—CHERRIES—Continued.

WASHINGTON.

	Cars.
Benton County:	
July—	
Kennewick	5
Prosser	4
Chelan County:	
July—	
Cashmere	7
Wenatchee	73
Spokane County:	
July 20-29—	
Spokane	11

WASHINGTON—Continued.

	Cars.
Walla Walla County:	
July 1-29—	
Walla Walla	4
Yakima County:	
June 24-July 9—	
North Yakima	10
Zillah	2
Wash., State total	116

WISCONSIN.

	Cars.
Door County:	
July 16-Aug. 15—	
Sturgeon Bay	97
Wis., State total	97

Table 4.—GRAPES.

ARIZONA.

	Cars.
Maricopa County:	
July 2-10—	
Mesa	9
Ariz., State total	9

ARKANSAS.

Franklin County:	
Aug. 1-3—	
Altus	3
Washington County:	
Aug. 1-Sept. 1—	
Tontitown	12
Ark., State total	15

CALIFORNIA.

Butte County:	
Aug.-Nov.—	
East Gridley	47
Midvale	15
Contra Costa County:	
Sept. 21-Nov. 15—	
Concord	53
Cowell	12
Muir	4
Oakley	35
Fresno County:	
July 1-Nov. 30—	
Bowles	78
Del Rey	141
Fresno	409
Lone Star	168
Minkler	86
Parlier	443
Reedley	281
Imperial County:	
June 17-July 31—	
Brawley	11
El Centro	25
Heber	18
Holtville	8
Imperial	33
Meloland	10
Kern County:	
Sept. 1-28—	
Bakersfield	1
Wasco	15
Kings County:	
Aug.—	
Hanford	56
Los Angeles County:	
June 13-Nov. 20—	
Arcadia	17
Bassett	1
Burbank	54
Glendale	9
Lamanda Park	3
Lankershim	8
Los Angeles	15
Owensmouth	1
Pasadena	2
San Fernando	2
San Gabriel	3
Van Nuys	2
West Glendale	6
Whittier	1

CALIFORNIA—Continued.

	Cars.
Orange County:	
Oct. 14—	
Anaheim	2
Santa Ana	1
Riverside County:	
June 10-July 6—	
Beaumont	1
Coachella	10
Mecca	5
Sacramento County:	
Aug. 30-31—	
Elk Grove	1
Sacramento	1
San Bernardino County:	
Aug.-Nov.—	
Cucamonga	60
Del Rosa	10
Etiwanda	86
Guasti	31
Muscat	18
San Bernardino	1
Upland	5
San Diego County:	
Aug. 6-Oct. 30—	
El Cajon	96
Escondido	42
San Diego	35
Santee	7
San Francisco County:	
Nov. 15—	
San Francisco	1
San Joaquin County:	
Aug. 26-Nov. 6—	
Acampo	1
Lodi	19
Youngstown	4
Solano County:	
August—	
Boynton	5
Sonoma County:	
Oct. 2-17—	
Sebastopol	10
Stanislaus County:	
July 18-Nov. 30—	
Denair	40
Empire	32
Hughson	8
Keyes	1
Modesto	13
Sutter County:	
Aug.-Oct.—	
Almendra	12
Encinal	5
Harter	7
Live Oak	2
Nuestro	7
Pease	5
Sanders	1
Yuba City	43
Tulare County:	
July 16-Nov. 29—	
Cutler	123
Exeter	38
Lindsay	38
North Dinuba	365
Seville	52
Sultana	143

CALIFORNIA—Continued.

	Cars.
Ventura County:	
Oct. 20—	
Santa Susanna	1
Yolo County:	
Aug.-Oct.—	
Woodland	11
Yuba County:	
Aug.-Sept.—	
Marysville	5
Cal., State total	3,477

COLORADO.

Denver County:	
Sept. 21—	
Denver	1
Weld County:	
Aug. 26—	
Greeley	1
Colo., State total	2

DELAWARE.

Kent County:	
Aug. 16-Sept. 20—	
Clayton	23
Hartly	1
Wyoming	10
Del., State total	34

GEORGIA.

Fulton County:	
Oct. 17—	
Atlanta	1
Ga., State total	1

ILLINOIS.

Cook County:	
Aug. 7-Nov. 23—	
Chicago	28
Peoria County:	
Sept. 23—	
Peoria	1
Winnebago County:	
Aug. 24—	
Rockford	1
Ill., State total	30

IOWA.

Harrison County:	
Sept. 9-16—	
Missouri Valley	2
Mondamin	2
Keokuk County:	
Sept. 2—	
Gibson	1
Lee County:	
Aug. 20-Sept. 25—	
Fort Madison	2
Keokuk	1
Montrose	57

DECIDUOUS FRUITS—Continued.

Table 4.—GRAPES—Continued.

IOWA—Continued.

	Cars.
Polk County:	
Aug. 31—	
Des Moines	1
Pottawattamie County:	
June–Sept.—	
Council Bluffs	77
Wapello County:	
Sept. 14—	
Ottumwa	1
Iowa, State total	144

KANSAS.

Doniphan County:	
Aug. 16–Sept. 10—	
Blair	1
Wathena	29
Kans., State total	30

LOUISIANA.

Orleans Parish:	
Sept. 16–20—	
New Orleans	2
La., State total	2

MARYLAND.

Baltimore City:	
July 15–Dec. 6—	
Baltimore	126
Aug. 31–Sept. 21:	
Chester River landings	1
Md., State total	127

MASSACHUSETTS.

Essex County:	
Oct. 18—	
Lawrence	1
Suffolk County:	
Oct. 24–Dec. 8—	
Boston	5
Mass., State total	6

MICHIGAN.

Allegan County:	
Sept. 5–26—	
Fennville	6
Berrien County:	
Sept.–Oct.—	
Baroda	69
Benton Harbor	257
Berrien Springs	5
Bridgman	52
Coloma	22
Derby	168
Galien	4
Niles	3
Riverside	2
St. Joseph	255
Sawyer	29
Sodus	38
Stevensville	48
Watervliet	2
Cass County:	
Sept. 30–Oct.—	
Dowagiac	5
Edwardsburg	1
Marcellus	26
Grand Traverse County:	
Oct. 7—	
Traverse City	1
Kalamazoo County:	
Oct.—	
Williams	6
Kent County:	
Sept.—	
Grand Rapids	2

MICHIGAN—Continued.

	Cars.
Mason County:	
Sept. 25–Oct. 6—	
Ludington	3
Muskegon County:	
Oct. 7–23—	
Slocum	3
Ottawa County:	
Sept. 8–Oct. 18—	
Grand Haven	40
Van Buren County:	
Sept. 7–Oct.—	
Bangor	1
Breedsville	1
Decatur	18
Hartford	15
Kendall	1
Lawrence	3
Lawton	336
Mattawan	155
Paw Paw	272
Mich., State total	1,849

MINNESOTA.

Beltrami County:	
Sept.—	
Bemidji	1
Hennepin County:	
Sept.—	
Minneapolis	4
Minn., State total	5

MISSOURI.

Andrew County:	
Sept. 14—	
Amazonia	1
Buchanan County:	
Aug. 18–Sept. 14—	
St. Joseph	17
Newton County:	
Aug. 7–8—	
Neosho	3
Taney County:	
Aug. 19–Sept. 2—	
Hollister	16
Mo., State total	37

MONTANA.

Silverbow County:	
Nov. 3—	
Butte	1
Mont., State total	1

NEBRASKA.

Adams County:	
Aug.—	
Hastings	2
Douglas County:	
Aug. 1–Oct. 7—	
De Bolt Place	3
Florence	28
Omaha	56
Hall County:	
Nov.—	
Grand Island	21
Nemaha County:	
Aug. 24—	
Brownville	2
Julian	1
Nebr., State total	113

NEW JERSEY.

Atlantic County:	
Sept.—	
Landisville	3
Hudson County:	
Oct. 18–Dec. 31—	
Manhattan Piers	179

NEW JERSEY—Continued.

	Cars.
Monmouth County:	
Sept. 26–30—	
Hazlet	2
N. J., State total	184

NEW YORK.

Albany County:	
Sept.–Nov.—	
Albany	2
Cattaraugus County:	
Oct. 3–Nov. 2—	
Perrysburg	97
Chautauqua County:	
Aug.–Nov.—	
Brocton	423
Dunkirk	28
Forestville	137
Fredonia	241
Irving	90
Laona	44
Mayville	17
Portland	332
Prospect	16
Ripley	352
Sheridan	118
Silver Creek	132
Smith's Mills	44
State Line	133
Westfield	148
Columbia County:	
Aug.–Oct.—	
Germantown	19
Dutchess County:	
Sept.–Oct.—	
Barrytown	2
Cokertown	4
Tivoli	8
Erie County:	
Sept. 1–Dec. 18—	
Angola	42
Buffalo	2
Derby	3
Eden Center	47
Farnham	2
North Collins	66
Kings County:	
Oct. 15–Nov.—	
Brooklyn	7
Monroe County:	
Oct.—	
Brockport	3
Union Hill	2
New York County:	
Aug. 15–Dec. 8—	
New York	16
Niagara County:	
Sept.–Oct.—	
Cambria	3
Elberta	6
Gasport	9
Lockport	67
Model City	28
Ransomville	6
Sanborn	12
Wilson	9
Onondaga County:	
Sept.—	
Syracuse	1
Ontario County:	
Sept. 13–Oct. 28—	
Canandaigua	25
Naples	124
Orleans	21
Orange County:	
Aug. 22–Oct.—	
Cedar Cliff	8
Newburgh	2
Roseton	17
Orleans County:	
Sept.—	
Fancher	3

DECIDUOUS FRUITS—Continued.

Table 4.—GRAPES—Continued.

NEW YORK—Continued.

	Cars.
Oswego County:	
Sept.—	
Lacona	32
Richmond County:	
Oct. 18–Dec. 30—	
St. George Lighterage	70
Schuyler County:	
Sept. 18–Nov. 11—	
Hector	61
Valois	30
Seneca County:	
Sept. 22–Nov. 16—	
Caywood	14
Kendaia	62
Romulus	20
Seneca Falls	4
Yale	1
Steuben County:	
Sept.–Nov.—	
Hammondsport	199
Ulster County:	
Aug. 22–Oct. 26—	
Clintondale	2
Esopus	9
Highland	29
Marlboro	98
Milton	19
St. Elmo	1
Ulster Park	49
West Park	9
Wayne County:	
Oct.—	
Ontario	6
Sodus	8
Yates County:	
Sept. 20–Nov. 23—	
Bluff Point	127
Branchport	70
Dresden	20
Dundee	1
Glenora	1
Himrod	32
Middlesex	137
Milo	1
Penn Yan	508
Rock Stream	2
Starkey	45
N. Y., State total	4,585

NORTH CAROLINA.

Martin County:	
Sept. 1–Oct. 3—	
Everetts	9
Moore County:	
July 26—	
Aberdeen	3
Southern Pines	1
N. C., State total	13

OHIO.

	Cars.
Ashtabula County:	
Oct. 1–30—	
Ashtabula	1
Conneaut	3
Geneva	9
Saybrook	3
Cuyahoga County:	
Oct. 26–Nov. 17—	
Dover	31
Erie County:	
Oct. 5–12—	
Berlin Heights	2
Ceylon	2
Vermillion	9
Franklin County:	
Sept. 8–Oct. 30—	
Columbus	9
Geauga County:	
Oct. 25—	
Chardon	1
Hamilton County:	
Sept. 8—	
Cincinnati	1
Lake County:	
Sept. 21–Nov. 1—	
Madison	19
Perry	51
Unionville	104
Lorain County:	
Sept. 26–Oct. 7—	
Avon	21
Ottawa County:	
Sept. 10–Oct. 8—	
Danbury	1
Put in Bay	1
Ohio, State total	268

OREGON.

Multnomah County:	
Aug. 3–Nov. 15—	
East Portland	2
Portland	24
Oreg., State total	26

PENNSYLVANIA.

Erie County:	
Sept.–Nov.—	
Erie	13
Fairview	6
Girard	9
Harbour Creek	252
Moorheads	63
North East	666
Springfield	3
Philadelphia County:	
Sept.—	
Philadelphia	18
Tioga County:	
Oct.—	
Westfield	18
Pa., State total	1,048

SOUTH DAKOTA.

	Cars.
Minnehaha County:	
Sept.—	
Sioux Falls	10
S. Dak., State total	10

TENNESSEE.

Sumner County:	
Aug. 31—	
Hendersonville	1
Tenn., State total	1

TEXAS.

Dallas County:	
Aug.–Oct. 21—	
Dallas	3
Maverick County:	
July 17—	
Eagle Pass	1
Tarrant County:	
July 18–Sept. 22—	
Fort Worth	7
Tex., State total	11

VIRGINIA.

Greenesville County:	
Aug. 25–28—	
Emporia	2
Va., State total	2

WASHINGTON.

Benton County:	
Sept. 8—	
Kennewick	1
Yakima County:	
Oct. 8–14—	
Granger	5
North Yakima	17
Selah	6
Zillah	1
Wash., State total	30

WEST VIRGINIA.

Wood County:	
Oct. 2—	
Parkersburg	1
W. Va., State total	1

WISCONSIN.

Fond du Lac County:	
Sept.—	
Fond du Lac	1
Wis., State total	1

Table 5.—PEACHES.

ALABAMA.

	Cars.
Bullock County:	
June 23–July 18—	
Peachburg	5
Escambia County:	
July 3—	
Atmore	1
Marion County:	
July 18—	
Lumbull	1
Walker County:	
June–Aug. 2—	
Jasper	1
Manchester	1
Parrish	1
Ala., State total	10

ARKANSAS.

	Cars.
Benton County:	
July–Aug.—	
Rogers	52
Boone County:	
July 29–Aug. 8—	
Bellefonte	1
Harrison	8
Calhoun County:	
July—	
Thornton	5
Clark County:	
June 5–July 21—	
Amity	32
Arkadelphia	14
Gum Springs	1

ARKANSAS—Continued.

	Cars.
Clay County:	
July—	
Piggott	4
Columbia County:	
July 11–20—	
Magnolia	7
Waldo	2
Conway County:	
July–Aug.—	
Morrillton	25
Crawford County:	
July 15–Aug. 26—	
Alma	243
Dyer	30
Mountainburg	12
Rudy	4
Van Buren	15

DECIDUOUS FRUITS—Continued.

Table 5.—PEACHES—Continued.

ARKANSAS—Continued.

	Cars.
Franklin County:	
July 16–28—	
Altus	8
Branch	2
Charleston	2
Ozark	11
White Oak	5
Fulton County:	
Aug.—	
Mammoth Springs	12
Hempstead County:	
July 1–Aug. 1—	
Belton	2
Hope	20
Washington	2
Howard County:	
July–Aug.—	
Mineral Springs	10
Nashville	139
Johnson County:	
July 13–Aug. 26—	
Cabin Creek	84
Clarksville	157
Coal Hill	39
Hartman	6
Knoxville	5
Lafayette County:	
July 18—	
Bradley	1
Lawrence County:	
July 28–Aug. 5—	
Alicia	1
Ravenden	1
Little River County:	
July 15–19—	
Ashdown	3
Wilton	1
Logan County:	
July 15–Aug. 10—	
Blue Mountain	7
Booneville	2
Magazine	2
Paris	1
Subiaco	2
Miller County:	
June 26–July 12—	
Texarkana	6
Ouachita County:	
July 3–23—	
Buena Vista	5
Camden	8
Chidester	15
Sayre	2
Stephens	10
Perry County:	
July 14–18—	
Adona	3
Pike County:	
July 5–29—	
Delight	6
Highland	702
Pike City	10
Rosboro	5
Polk County:	
July 15–22—	
Cove	1
Wickes	4
Pope County:	
July–Aug.—	
Atkins	7
Russellville	55
Scott County:	
July 19—	
Abbott	1
Searcy County:	
July—	
Marshall	4
Sebastian County:	
June 22–July 29—	
Barling	3
Greenwood	9
Hackett	11
Huntington	7
Lavaca	8
Mansfield	2

ARKANSAS—Continued.

	Cars.
Sevier County:	
July 6–19—	
De Queen	3
Gillham	1
Horatio	43
Lockesburg	14
Sharp County:	
July–Aug.—	
Hardy	3
Williford	3
Union County:	
July—	
El Dorado	41
Strong	5
Yell County:	
July 13–25—	
Belleville	2
Dardanelle	58
Waveland	3
Ark., State total	2,040

CALIFORNIA.

Butte County:	
June–Aug.—	
East Gridley	14
Rio Bonito	1
Riviera	6
Contra Costa County:	
Sept. 6–8—	
Concord	2
Fresno County:	
Apr. 22–Sept. 30—	
Bowles	28
Del Rey	20
Fresno	6
Laton	5
Parlier	224
Reedley	46
Kern County:	
Aug. 1—	
Wasco	1
Kings County:	
Aug.—	
Hanford	49
Los Angeles County:	
June 30–July 22—	
Lankershim	1
Los Angeles	2
Riverside County:	
July 6–Aug. 31—	
Banning	15
Beaumont	9
Sacramento County:	
July—	
Sacramento	1
San Bernardino County:	
July 6–Aug. 25—	
Cucamonga	2
San Francisco County:	
July 22—	
San Francisco	1
San Joaquin County:	
July 22–Aug. 27—	
Fine	3
Linden	3
Palora	9
Solano County:	
June–Aug.—	
Danielson	59
Fairfield	15
Suisun	1
Willotta	81
Stanislaus County:	
July 19–Aug. 29—	
Denair	6
Sutter County:	
June–Aug.—	
Encinal	6
Live Oak	7
Walton	5
Yuba City	1

CALIFORNIA—Continued.

	Cars.
Tulare County:	
June 6–July 30—	
Cutler	1
North Dinuba	9
Sultana	21
Visalia	41
Yettem	7
Yuba County:	
June–Aug.—	
Reed	40
Cal., State total	748

COLORADO.

Delta County:	
Aug. 10–Sept. 22—	
Austin	5
Paonia	250
Denver County:	
Aug. 30—	
Denver	1
Mesa County:	
July 29–Sept. 13—	
Clifton	58
Grand Junction	4
Palisade	794
Colo., State total	1,112

CONNECTICUT.

Hartford County:	
Sept.—	
New Britain	4
Middlesex County:	
Aug. 23–Sept. 24—	
Middlefield	45
New Haven County:	
Sept. 14–23—	
East Wallingford	29
Conn., State total	78

DELAWARE.

Kent County:	
Aug. 12–26—	
Farmington	2
Woodside	4
Wyoming	35
Sussex County:	
Aug. 8–24—	
Bridgeville	3
Cannon	2
Delmar	2
Milford	2
Milton	12
Selbyville	9
Del., State total	71

FLORIDA.

Lake County:	
May 16–18—	
Umatilla	2
Fla., State total	2

GEORGIA.

Bartow County:	
June 26–July 25—	
Adairsville	24
Emerson	11
Hall	1
Bibb County:	
July 4–24—	
Lizella	17
Macon	11

DECIDUOUS FRUITS—Continued.

Table 5.—PEACHES—Continued.

GEORGIA—Continued.

	Cars.
Chattooga County:	
July—	
Holland	4
Menlo	1
Summerville	23
Cobb County:	
July 18–21—	
Marietta	5
Coweta County:	
July 23–29—	
Newnan	4
Crawford County:	
July 10–21—	
Musella	21
Roberta	3
Zenith	40
DeKalb County:	
July 15–17—	
Stone Mountain	3
Elbert County:	
July 13–20—	
Middleton	8
Floyd County:	
June–July—	
Chambers	3
Rome	1
Silver Creek	4
Glasscock County:	
July 11–18—	
Agricola	14
Gordon County:	
July 21—	
Calhoun	1
Habersham County:	
June 28–July 28—	
Alto	3
Baldwin	44
Cornelia	14
Hollywood	1
Hall County:	
June 23–July 15—	
Gainesville	2
Hancock County:	
June 23–July 18—	
Culverton	2
Mayfield	50
Harris County:	
June 30–July 8—	
Shiloh	3
Houston County:	
June 2–July 28—	
Bonaire	6
Byron	379
Elko	2
Fort Valley	1,132
Grovania	2
Perry	12
Wellston	2
Wilson	2
Jackson County:	
June 5–Aug. 15—	
Commerce	5
Jefferson	1
Pendergrass	5
Jasper County:	
June 26–Aug. 2—	
Hillsboro	22
Jones County:	
June 13–Aug. 15—	
Bradley	90
Gray	91
James	27
Round Oak	13
Wayside	15
McDuffie County:	
July 10–15—	
Thomson	10
Macon County:	
June 8–July 30—	
Marshallville	577
Montezuma	174
Winchester	95

GEORGIA—Continued.

	Cars.
Meriwether County:	
July 12–29—	
Warm Springs	37
Woodbury	65
Monroe County:	
July—	
Bolingbroke	1
Dyas	8
Goggins	11
Pike County	
July 6–22—	
Barnesville	13
Williamson	27
Zebulon	2
Polk County:	
July—	
Rockmart	4
Putnam County:	
July 11–14—	
Meda	4
Willard	1
Spalding County:	
July 14–18—	
Zetella	2
Stewart County:	
June 28–July 19—	
Renfroe	1
Richland	5
Sumter County:	
July 10—	
Americus	1
Taylor County:	
June—	
Bulter	6
Reynolds	50
Upson County:	
June 20–July 19—	
Crest	14
The Rock	3
Thomaston	8
Yatesville	49
Warren County:	
July 6–14—	
Norwood	8
Ga., State total	3,300

IDAHO.

Canyon County:	
Aug. 13—	
Emmett	1
Nez Perce County:	
Sept. 2—	
Lewiston	1
Twin Falls County:	
Sept. 16–22—	
Buhl	3
Idaho, State total	5

ILLINOIS.

Bond County:	
Aug. 31—	
Greenville	1
Bureau County:	
Aug.—	
Wyanet	1
Carroll County:	
July 27—	
Milledgeville	1
Clay County:	
Aug. 23–Sept. 1—	
Flora	14
Cook County:	
Aug. 23–Sept. 1—	
Chicago	11
Cumberland County:	
Aug. 1–25—	
Neoga	5
Jackson County:	
Aug. 4–Sept. 1—	
Makanda	25

ILLINOIS—Continued.

	Cars.
Johnson County:	
Aug. 13–17—	
Ozark	2
Vienna	1
Knox County:	
July 7–28—	
Galesburg	7
Marion County:	
Aug. 16–31—	
Cartter	4
Centralia	45
Kell	5
Kinmundy	2
Walnut Hills	4
Union County:	
July 20–Sept. 30—	
Alto Pass	8
Anna	5
Cobden	200
Washington County:	
Aug. 24–31—	
Irvington	27
Ill., State total	368

INDIANA.

Knox County:	
Aug. 22–Sept. 1—	
Decker	14
Lake County:	
Aug.—	
Indiana Harbor	1
Lawrence County:	
Aug. 19–24—	
Mitchell	9
St. Joseph County:	
July 19—	
South Bend	1
Ind., State total	25

IOWA.

Blackhawk County:	
July 27–31—	
Waterloo	2
Dubuque County:	
Sept. 20—	
Dubuque	1
Lee County:	
Sept.—	
Keokuk	3
Montrose	1
Muscatine County:	
Aug. 9—	
Muscatine	1
Scott County:	
July 31–Sept.—	
Davenport	4
Wapello County:	
Sept. 4—	
Ottumwa	1
Iowa, State total	13

KANSAS.

Dickinson County:	
Aug. 2—	
Solomon	1
Saline County:	
Oct. 20—	
Saline	1
Kans., State total	2

KENTUCKY.

Warren County:	
Aug. 1—	
Bowling Green	1
Ky., State total	1

DECIDUOUS FRUITS—Continued.

Table 5.—PEACHES—Continued.

LOUISIANA.

	Cars.
Caddo Parish:	
July 19—	
Shreveport	1
Claiborne Parish:	
July 11–14—	
Athens	2
Orleans Parish:	
Sept. 25—	
New Orleans	1
Webster Parish:	
July 13–16—	
Minden	2
La., State total	6

MARYLAND.

Allegany County:	
Aug. 1–Oct. 21—	
Cumberland	7
Rawlings	35
Town Creek	6
Anne Arundel County:	
Aug. 29–Sept. 4—	
Conway	2
Baltimore City:	
July 5–Oct. 20—	
Baltimore	20
Cecil County:	
July 25–Aug. 1—	
Perryville	2
Dorchester County:	
Aug. 10–27—	
Cambridge	3
Rhodesdale	4
Frederick County:	
Aug. 29—	
Point of Rocks	4
Thurmont	1
Hartford County:	
Aug.—	
Highland	3
Queen Annes County:	
Aug. 23—	
Love Point	1
Talbot County:	
Aug. 21—	
Claiborne	1
Cordova	3
Washington County:	
July–Oct.—	
Big Pool	19
Cherry Run	10
Chewsville	5
Edgemont	6
Hancock	125
Keedysville	8
Pearre	35
Rohrersville	20
Smithsburg	142
Weverton	1
Wicomico County:	
June 25–July 31—	
Salisbury	12
Worcester County:	
July 25–Aug. 24—	
Berlin	36
July–Sept. 12:	
Chester River landings	10
July–Sept. 1:	
Choptank River landings	28
Aug. 3–22:	
Nanticoke River landings	5
June–Sept. 8:	
Patuxent River landings	18
July–Aug. 4:	
Wicomico River landings	4
Md., State total	576

MASSACHUSETTS.

	Cars.
Suffolk County:	
Aug. 1–Sept. 7—	
Boston	4
Mass., State total	4

MICHIGAN.

Allegan County:	
Aug. 25–Sept. 30—	
Allegan	2
Fennville	71
Benzie County:	
Aug. 23–Oct. 17—	
Beulah	6
Frankfort	34
Berrien County:	
Aug. 22–Oct. 12—	
Benton Harbor	684
Bridgman	2
Coloma	379
Derby	27
Eau Claire	9
Niles	2
Riverside	6
St. Joseph	21
Sawyer	7
Sodus	29
Watervliet	9
Genesee County:	
Sept.—	
Fenton	1
Grand Traverse County:	
Sept. 5–Oct. 6—	
Traverse City	30
Kent County:	
Sept. 13–Oct. 9—	
Grand Rapids	34
Lapeer County:	
Sept. 25—	
Attica	1
Manistee County:	
Aug. 26–Oct. 3—	
Arcadia	7
Copemish	2
Manistee	3
Norwalk	1
Onekama	1
Mason County:	
Aug. 10–Oct. 26—	
Custer	18
Freesoil	7
Ludington	246
Scottville	1
Muskegon County:	
Sept. 5–Oct. 3—	
Bailey	11
Brunswick	5
Casnovia	19
Slocum	14
Whitehall	1
Newaygo County:	
Sept. 3–30—	
Fremont	34
Grant	1
Reeman	5
Oakland County:	
Sept. 1–30—	
Holly	40
Oceana County:	
Aug. 12–Oct. 30—	
Hart	47
Mears	3
New Era	6
Pentwater	1
Shelby	104
Sanilac County:	
Oct. 5—	
McGregor	1

MICHIGAN—Continued.

	Cars.
Van Buren County:	
Aug. 16–Oct.—	
Bangor	30
Covert	72
Grand Junction	1
Hartford	104
Kibbie	67
Lacota	9
Lawrence	1
McDonald	7
South Haven	62
Wayne County:	
Aug.—	
Detroit	1
Mich., State total	2,286

MINNESOTA.

Hennepin County:	
Aug.—	
Minneapolis	2
Ramsey County—	
Sept. 7—	
St. Paul	1
Minn., State total	3

MISSISSIPPI.

Union County:	
June 28–July 14—	
Ingomar	4
Miss., State total	4

MISSOURI.

Barry County:	
Aug.—	
Purdy	4
Carter County:	
Aug. 2–9—	
Hunter	4
Howell County:	
July 30–Oct. 3—	
Brandsville	76
Jackson County:	
Sept.–Oct.—	
Kansas City	2
Oregon County:	
July 29–Aug. 12—	
Koshkonong	117
Thayer	5
Ripley County:	
Aug. 7—	
Doniphan	2
Mo., State total	210

NEBRASKA.

Adams County:	
Aug.—	
Hastings	2
Dakota County:	
Aug.—	
South Sioux City	1
Dawson County:	
Aug.—	
Adams	200
Dodge County:	
Aug. 4—	
Fremont	1
Douglas County:	
July 19—	
Omaha	1
Franklin County:	
Aug.—	
Hildreth	1
Lancaster County:	
July 20–Sept. 5—	
Hickman	2
Lincoln	6

DECIDUOUS FRUITS—Continued.

Table 5.—PEACHES—Continued.

	Cars.
NEBRASKA—Continued.	
Merrick County:	
Oct. 1—	
Chapman	1
Red Willow County:	
Aug.	
Lebanon	1
Nebr., State total	216
NEW JERSEY.	
Atlantic County:	
July 10–Sept. 15—	
Hammonton	189
Landisville	120
Wheat Road	10
Burlington County:	
July 1–Sept. 20—	
Beverly	41
Edgewater Park	107
Jobstown	2
Mount Holly	21
Riverton	1
West Moorestown	2
Camden County:	
July 23–Sept. 22—	
Elm	248
Merchantville	4
Cumberland County—	
Aug. 9–Sept. 9—	
Bridgeton	2
Vineland	100
Gloucester County:	
July 27–Sept. 14—	
Glassboro	53
Iona	17
Mickleton	3
Richwood	23
Swedesboro	11
Williamstown	11
Hunterdon County:	
Aug. 14–Oct. 7—	
Califon	8
Flemington	3
High Bridge	22
Lebanon	140
Pittstown	1
White House	35
Monmouth County:	
Aug.—	
Red Bank	3
Salem County:	
Aug. 26–Sept. 7—	
Pedricktown	2
N. J., State total	1,179
NEW YORK.	
Albany County:	
July–Sept.—	
Albany	9
Allegany County:	
Sept. 3—	
Cuba	1
Broome County:	
Aug. 3–Sept. 30—	
Barker	9
Binghamton	5
Chemung County:	
Aug. 12–Sept. 30—	
Elmira	3
Columbia County:	
Aug.—	
Germantown	1
Erie County:	
Aug.–Sept. 22—	
Buffalo	3
Monroe County:	
Aug. 1–Oct.—	
Adams Basin	38
Barnard	40
NEW YORK—Continued.	
Monroe County—Contd.	
Aug. 1–Oct.—	
Brockport	59
Charlotte	49
Greece	5
Hamlin	121
Hilton	197
Mortimer	1
Morton	193
Rochester	108
Spencerport	104
Union Hill	1
Uptonville	109
Walker	99
Webster	10
Montgomery County:	
Oct.—	
Amsterdam	1
Niagara County:	
Aug. 10–Oct. 20—	
Appleton	96
Barker	310
Burt	385
Elberta	100
Gasport	99
Lewiston	466
Lockport	134
Middleport	74
Model City	164
Newfane	33
Olcott	78
Ransomville	118
Wilson	224
Onondaga County:	
Sept. 16–Oct. 20—	
Syracuse	2
Ontario County:	
Sept.—	
Geneva	1
Orange County:	
Aug. 1–Oct. 15—	
Cedar Cliff	1
Pine Island	3
Roseton	2
Orleans County:	
Aug. 1–Oct. 15—	
Albion	96
Ashwood	58
Brice	56
Carlton	43
Fancher	58
Holley	37
Kendall	107
Knowlesville	6
Lyndonville	358
Medina	142
Millers	147
Waterport	80
Schuyler County:	
Sept. 12–Oct. 13—	
Hector	13
Seneca County:	
Sept. 1–Oct. 17—	
Caywood	8
Junius	32
Lodi	3
Steuben County:	
Sept. 30–Oct. 31—	
Corning	2
Suffolk County:	
Sept.—	
Calverton	4
Ulster County:	
Aug. 7–25—	
Marlboro	2
Milton	5
Ulster Park	1
West Park	2
Wayne County:	
Sept. 1–Oct.—	
East Williamson	33
Fruitland	37
NEW YORK—Continued.	
Wayne County—Contd.	
Sept. 1–Oct.—	
Ontario	31
Sodus	67
Wallington	3
Williamson	214
Westchester County:	
Sept.—	
Tarrytown	1
Yates County:	
Sept. 26–30—	
Bellona	1
Penn Yan	1
N. Y., State total	5,104
NORTH CAROLINA.	
Harnett County:	
June—	
Spout Springs	2
Montgomery County:	
July 4–28—	
Candor	22
Moore County:	
June 5–July 26—	
Aberdeen	31
Eagle Springs	2
Southern Pines	10
Vance County:	
June 8–12—	
Kittrell	8
N. C., State total	75
OHIO.	
Cuyahoga County:	
July 13–Sept. 25—	
Cleveland	7
Cleveland Pier	2
Erie County:	
Aug. 22–Oct. 15—	
Berlin Heights	23
Castalia	6
Ceylon	7
Kelleys Island	6
Sandusky	1
Vermillion	29
Franklin County:	
July 13–Sept. 25—	
Columbus	3
Hamilton County:	
Aug. 9–Sept. 6—	
Cincinnati	2
Glendale	5
Woodlawn	6
Huron County:	
Oct. 1–15—	
Norwalk	13
Lake County:	
Sept. 21–25—	
Unionville	2
Lucas County:	
Sept. 1–Oct. 6—	
Maumee	1
Toledo	14
Ottawa County:	
Aug. 1–Oct. 19—	
Catawba Island	81
Danbury	750
Gypsum	595
La Carne	217
Lakeside	97
Oak Harbor	353
Port Clinton	405
Put in Bay	2
Ross County:	
Aug.—	
Musselman	3
Ohio, State total	2,630

DECIDUOUS FRUITS—Continued.

Table 5.—PEACHES—Continued.

OKLAHOMA.

	Cars.
Bryan County:	
June 2–July 23—	
Bennington	1
Bokchito	3
Choctaw County:	
July–Aug.—	
Boswell	1
Fort Towson	6
Hugo	18
Haskell County:	
June 6–16—	
Keota	14
Hughes County:	
June 13–18—	
Holdenville	1
Wetumka	7
Jefferson County:	
June 21—	
Hastings	1
Le Flore County:	
June 9–10—	
Bokoshe	1
Cameron	1
Poteau	6
Spiro	1
Lincoln County:	
June—	
Tryon	3
McCurtain County:	
June 10–July 21—	
Idabel	3
Valliant	7
Pushmataha County:	
July 5—	
Clayton	1
Seminole County:	
July—	
Konawa	10
Okla., State total	85

OREGON.

Baker County:	
Oct. 18—	
Huntington	1
Jackson County:	
Sept. 1–Oct. 12—	
Ashland	2
Malheur County:	
Sept. 16–27—	
Brogan	5
Multnomah County:	
Aug. 31–Oct. 13—	
East Portland	2
Wasco County:	
Aug. 13–Sept. 8—	
The Dalles	4
Oreg., State total	14

PENNSYLVANIA.

Adams County:	
Aug. 22–Oct. 20—	
Bendersville	5
Biglerville	28
Guernsey	5
Orrtanna	2
Allegheny County:	
Oct. 7–18—	
Allegheny	2
Berks County:	
Aug. 4–Oct. 14—	
Bechtelsville	2
Hamburg	22
Lenhartsville	8
Pine Forge	11
Bucks County:	
Aug. 14–Sept. 13—	
Doylestown	11

PENNSYLVANIA—Continued.

	Cars.
Chester County:	
Sept. 9–13—	
Parksburg	2
Cumberland County:	
Aug. 9–Oct. 7—	
Bowmansdale	8
Gettysburg Junction	62
Hunter's Run	45
Mechanicsburg	1
Shippensburg	10
Starners	22
Franklin County:	
Aug. 9–Oct. 7—	
Chambersburg	13
East Fayetteville	19
Lehmasters	3
Mason and Dixon	1
Midvale	11
Mont Alto	2
Quincy	10
Scotland	15
Waynesboro	8
Williamson	3
Indiana County:	
Sept.—	
Rossiter	1
Lackawanna County:	
Sept.—	
Carbondale	1
Scranton	12
Lancaster County:	
Aug. 15–Oct. 1—	
Peach Bottom	4
Lawrence County:	
Aug. 30–Sept. 26—	
Newport	4
Lebanon County:	
Sept. 11—	
Myerstown	1
Lehigh County:	
Aug. 18–Sept. 8—	
Walbert	9
Luzerne County:	
Sept.—	
Hazleton	8
Lycoming County:	
Sept. 11–21—	
Trout Run	9
Williamsport	1
Montgomery County:	
Aug. 9–Sept. 12—	
Norristown	3
Oaks	2
Pottstown	8
Northampton County:	
Aug. 24–Oct. 2—	
Easton	13
Philadelphia County:	
Aug. 12–Sept. 7—	
Philadelphia	49
Schuylkill County:	
Aug.—	
Mahanoy City	1
Union County:	
Aug. 15—	
Millmont	1
York County:	
Aug.–Sept.—	
Dillsburg	20
Mount Wolf	1
Wiley	15
Pa., State total	494

RHODE ISLAND.

Providence County:	
July 22–Sept. 27—	
Providence	3
R. I., State total	3

SOUTH CAROLINA.

	Cars.
Edgefield County:	
July 4–25—	
Meriwether	21
Greenville County:	
July—	
Greer	1
S. C., State total	22

SOUTH DAKOTA.

Minnehaha County:	
July 25—	
Sioux Falls	1
S. Dak., State total	1

TENNESSEE.

Morgan County:	
July—	
Lancing	2
Tenn., State total	2

TEXAS.

Anderson County:	
June 28–July 24—	
Frankston	51
Bowie County:	
July 8–21—	
De Kalb	12
Maud	8
Redwater	2
Callahan County:	
July—	
Clyde	1
Camp County:	
July 8–24—	
Leesburg	12
Newsome	10
Pittsburg	37
Cass County:	
July 10–25—	
Atlanta	35
Avinger	2
Hughes Springs	5
Lanier	5
Linden	3
Cherokee County:	
June 20–Aug. 1—	
Alto	31
Jacksonville	31
Mt. Selman	27
Collin County:	
July 8–11—	
Cookville	8
Comanche County:	
July 20–Aug. 15—	
De Leon	5
Dallas County:	
Aug.–Sept.—	
Dallas	2
Eastland County:	
July 27–Aug. 4—	
Gorman	2
Erath County:	
July 15–Aug. 10—	
Dublin	5
Fannin County:	
June 21–July 30—	
Bonham	5
Franklin County:	
June 23–July 26—	
Mt. Vernon	155
Grayson County:	
July 17–21—	
Whitesboro	6
Gregg County:	
July—	
Kilgore	10
Longview	16

DECIDUOUS FRUITS—Continued.

Table 5.—PEACHES—Continued.

TEXAS—Continued.

	Cars.
Harrison County:	
June 5–July 24—	
Hallsville	2
Harleton	3
Leigh	2
Marshall	4
Scottsville	34
Henderson County:	
June 15–July 28—	
Athens	99
Brownsboro	8
Chandler	31
La Rue	5
Murchison	24
Poynor	1
Hopkins County:	
June–Aug.—	
Como	44
Pickton	36
Saltillo	20
Sulphur Springs	93
Marion County:	
July 10–12—	
Jefferson	6
Morris County:	
June 17–July 20—	
Cason	1
Daingerfield	1
Naples	25
Omaha	18
Panola County:	
July—	
Beckville	1
Carthage	4
Rains County:	
June 23–Aug. 5—	
Emory	14
Red River County:	
July 10–Aug.—	
Avery	3
Bogata	5
Clarksville	1
Detroit	3
Rusk County:	
July—	
Overton	3
Tatum	1
Smith County:	
June 23–July 28—	
Arp	7
Flint	5
Lindale	101
Swan	9
Troup	1
Tyler	14
Whitehouse	5
Winona	176
Titus County:	
June 21–July 22—	
Mt. Pleasant	86
Winfield	45
Upshur County:	
June 21–July 21—	
Gilmer	17
Pritchett	5
Rosewood	7
Van Zandt County:	
July 10–28—	
Grand Saline	10
Wise County:	
July 28–Aug. 1—	
Alvord	1
Chico	1
Wood County:	
June 6–July 31—	
Mineola	18
Ogburn	15
Winnsboro	5
Tex., State total	1,506

UTAH.

	Cars.
Boxelder County:	
Sept. 1–23—	
Brigham	51
Willard	12
Davis County:	
Sept. 11–15—	
Farmington	2
Woods Cross	2
Salt Lake County:	
Sept. 5–9—	
Hot Springs	2
Salt Lake City	10
Utah County:	
Aug. 31–Sept. 16—	
Pleasant Grove	4
Provo	53
Springville	27
Weber County:	
Sept. 3–15—	
Ogden	38
Utah, State total	201

VIRGINIA.

Albemarle County:	
Aug. 5–14—	
Crozet	5
Greenwood	1
Botetourt County:	
Aug.—	
Cloverdale	6
Frederick County:	
Aug. 4–Sept. 14—	
Winchester	15
Loudoun County:	
July 31–Aug. 28—	
Bluemont	2
Clarkes Gap	51
Round Hill	1
Page County:	
Aug.—	
Luray	2
Rockingham County:	
Aug. 1–Oct. 1—	
Timberville	21
Shenandoah County:	
Aug. 9–Sept. 22—	
Mount Jackson	5
Strasburg	12
Woodstock	1
Va., State total	122

WASHINGTON.

Benton County:	
July 1–Oct. 15—	
Benton	17
Hanford	3
Kennewick	1
North Prosser	1
White Bluffs	5
Chelan County:	
Aug. 1–Oct. 6—	
Cashmere	2
Entiat	45
Monitor	1
Wenatchee	282
Grant County:	
Aug. 3–Sept. 28—	
Coulee City	3
Ephrata	1
Trinidad	3
Lincoln County:	
Sept. 18–23—	
Creston	3
Okanogan County:	
Sept. 12–21—	
Okanogan	76
Omak	7
Pateros	2
Snohomish County:	
Sept. 23—	
Everett	2

WASHINGTON—Continued.

	Cars.
Spokane County:	
Aug. 19–31—	
Spokane	2
Stevens County:	
Sept. 27–30—	
Meyers Falls	1
Walla Walla County:	
Aug. 23–Sept. 14—	
Walla Walla	2
Whitman County:	
Aug. 22–Sept. 9—	
Almota	6
Bishop	7
Yakima County:	
July 26–Oct. 21—	
Buena	60
Cutler	1
Donald	187
Flint	3
Fruitvale	6
Grandview	9
Granger	6
Naches	1
North Yakima	462
Parker	13
Piedmont	2
Sawyer	1
Selah	49
Shannon	12
Sunnyside	2
Toppenish	16
Wapato	29
Wright	25
Zillah	148
Wash., State total	1,504

WEST VIRGINIA.

Berkeley County:	
Aug. 18–25—	
Inwood	10
North Mountain	6
Grant County:	
Aug. 3–Sept. 15—	
Petersburg	62
Hampshire County:	
July 27–Oct. 19—	
French	51
Green Spring	14
Romney	505
Springfield	103
Hancock County:	
Aug. 31—	
Chester	1
Hardy County:	
Aug. 7–Sept. 13—	
McNeil	11
Moorefield	12
Mineral County:	
Aug. 11–Oct. 12—	
Keyser	55
Patterson's Creek	1
Morgan County:	
July 31–Oct. 16—	
Cherry Run	113
Hancock	34
Paw Paw	15
Wood County:	
Sept. 15–22—	
Parkersburg	2
W. Va., State total	995

WISCONSIN.

Milwaukee County:	
Sept. 16–25—	
Milwaukee	8
Winnebago County:	
July 17—	
Oshkosh	1
Wis., State total	9

DECIDUOUS FRUITS—Continued.

Table 6.—PEARS.

ARKANSAS.

	Cars.
Lafayette County:	
Aug. 17–Sept. 8—	
Buckner	15
Logan County:	
July 15–July 26—	
Subiaco	2
Ark., State total	17

CALIFORNIA.

Butte County:	
July—	
East Gridley	12
Riviera	4
Colusa County:	
July—	
Colusa	3
Contra Costa County:	
July 6–Oct. 2—	
Concord	108
Meinert	1
Muir	78
San Pablo	2
Imperial County:	
Oct. 31–Nov. 10—	
Calexico	3
Inyo County:	
Sept. 19—	
Kearsarge	1
Kern County:	
Aug. 13—	
Tehachapi	1
Los Angeles County:	
July 28–Oct. 3—	
Los Angeles	5
Palmdale	38
San Fernando	1
Riverside County:	
July 24–Aug. 25—	
Banning	10
Beaumont	1
Hemet	3
Murrieta	1
Sonoma County:	
July 24–Aug. 3—	
Sebastapol	5
Sutter County:	
July—	
Encinal	1
Yuba City	3
Ventura County:	
July 24—	
Santa Susanna	1
Yolo County:	
June–Aug.—	
Rose Orchard	54
Yuba County:	
June–Aug.—	
Howard	1
Reed	54
Cal., State total	391

COLORADO.

Delta County:	
Aug. 10–Sept. 2—	
Austin	2
Paonia	4
Mesa County:	
Aug. 2–Oct. 28—	
Clifton	148
Fruita	2
Grand Junction	110
Palisade	40
Colo., State total	306

DELAWARE.

	Cars.
Kent County:	
Sept.–Oct.—	
Cheswold	13
Clayton	7
Harrington	2
Hartly	20
Houston	3
Kenton	6
Smyrna	11
Viola	8
Woodside	8
Wyoming	91
New Castle County:	
Sept.—	
Mount Pleasant	3
Townsend	9
Sussex County:	
Sept.–Oct.—	
Bridgeville	17
Cannon	4
Lincoln City	10
Milford	7
Seaford	21
Del., State total	240

GEORGIA.

Dougherty County:	
Sept. 23—	
Albany	1
Lee County:	
July 28–Aug. 11—	
Leesburg	4
Smithville	9
Thomas County:	
July–Aug.—	
Thomasville	11
Ga., State total	25

IDAHO.

Latah County:	
Sept. 20–26—	
Moscow	3
Nez Perce County:	
Aug. 20–Sept. 24—	
Lewiston	4
Idaho, State total	7

ILLINOIS.

Clay County:	
Sept. 1–Oct. 5—	
Flora	31
Clinton County:	
Sept. 13–Oct. 31—	
Keysport	1
New Memphis	3
Shattuc	4
Cook County:	
Sept. 1–Oct. 5—	
Chicago	22
Crawford County:	
Oct. 4—	
Robinson	1
Effingham County:	
Sept. 29—	
Watson	1
Jackson County:	
Aug.–Nov. 1—	
Makanda	10
Johnson County:	
Sept. 26–Oct. 18—	
New Burnside	2
Ozark	1
Vienna	4
Knox County:	
Sept.—	
Galesburg	1
Macoupin County:	
Oct. 1–10—	
Shipman	2

ILLINOIS—Continued.

	Cars.
Madison County:	
Sept.–Oct.—	
Alton	1
East Alton	2
New Douglas	1
Marion County:	
Aug. 25–Oct. 26—	
Centralia	58
Inka	2
Kell	4
Patoka	4
Sandoval	35
Walnut Hills	14
Pulaski County:	
Sept.–Oct.—	
Villa Ridge	44
St. Clair County:	
Aug. 29—	
East St. Louis	1
Tazewell County:	
Sept.—	
Tremont	2
Union County:	
Sept.–Oct. 6—	
Alto Pass	1
Anna	11
Cobden	16
Washington County:	
Sept. 14–27—	
Irvington	7
Wayne County:	
Aug. 1–Oct. 21—	
Sims	2
Ill., State total	288

INDIANA.

Cass County:	
Oct.—	
Logansport	1
Clark County:	
Oct. 18—	
Borden	1
Delaware County:	
Oct. 24—	
Daleville	1
Gibson County:	
Sept. 7–Nov. 23—	
Haubstadt	2
Oakland City	1
Owensville	10
Princeton	19
Grant County:	
Oct. 17—	
Fairmount	1
Henry County:	
Oct. 6–25—	
Spiceland	5
Jefferson County:	
Oct. 24—	
Madison	2
Kosciusko County:	
Oct. 13—	
Mentone	1
Pike County:	
Oct. 4—	
Winslow	1
Posey County:	
Sept. 7–Oct. 14—	
Cynthiana	7
Griffin	1
New Harmony	21
Poseyville	23
Wadesville	5
Tippecanoe County:	
Oct. 24—	
La Fayette	1
Vanderburg County:	
Sept. 27—	
Ingle	1
Ind., State total	104

DECIDUOUS FRUITS—Continued.

Table 6.—PEARS—Continued.

IOWA.

	Cars.
Dubuque County:	
Sept. 11—	
Dubuque	1
Lee County:	
Oct. 2—	
Keokuk	1
Montrose	1
Marion County:	
Sept. —	
Hamilton	1
Wapello County:	
Sept. 18—	
Ottumwa	1
Iowa, State total	5

KANSAS.

Doniphan County:	
Sept. 26–Oct. 4—	
Troy	3
Douglas County:	
Sept. 29—	
Vinland	1
Jefferson County:	
Sept.—	
Oskaloosa	5
Kearney County:	
Oct. 20—	
Kearney	1
Kans., State total	10

KENTUCKY.

Jefferson County:	
Oct. 9—	
Louisville	1
McCraken County:	
Sept. 30—	
Maxon	1
Ky., State total	2

LOUISIANA.

Lincoln Parish:	
Nov.—	
Ruston	1
Orleans Parish:	
Aug. 18–Sept. 20—	
New Orleans	4
La., State total	5

MARYLAND.

Baltimore City:	
July 1–Oct. 23—	
Baltimore	33
Baltimore County:	
July—	
Price	3
Caroline County:	
Sept. 14—	
Ridgely	2
Harford County:	
Oct. 4–24—	
Perryman	9
Kent County:	
Oct. 10–Nov. 12—	
Blacks	2
Lambson	3
Lynch	2
Still Pond	5
Worton	9
Queen Annes County:	
Sept. 23–Oct. 3—	
Barclay	5
Worcester County:	
Oct. 5–18—	
Berlin	8
Aug. 1–Sept. 29—	
Chester River landings	17
Md., State total	98

MASSACHUSETTS.

	Cars.
Middlesex County:	
Oct. 17—	
Groton	1
Mass., State total	1

MICHIGAN.

Allegan County:	
Oct. 17–31—	
Bravo	4
East Saugatuck	2
Fennville	83
Berrien County:	
Aug. 1–Nov. 30—	
Baroda	16
Benton Harbor	187
Berrien Springs	6
Bridgman	1
Buchanan	3
Coloma	72
Derby	57
Eau Claire	16
Glendora	3
Niles	2
Riverside	24
St. Joseph	92
Sawyer	29
Sodus	28
Stevensville	21
Grand Traverse County:	
Sept. 1–Oct. 17—	
Old Mission	3
Traverse City	7
Hillsdale County:	
Oct.—	
Jonesville	1
Kent County:	
Aug. 31–Oct. 23—	
Caledonia	1
Fisher	1
Gooding	3
Grand Rapids	6
Sparta	1
Leelanau County:	
Sept. 26—	
Northport	1
Lenawee County:	
Oct.—	
Clinton	1
Sand Creek	1
Macomb County:	
Oct. 19–Nov. 2—	
Armada	2
Romeo	2
Manistee County:	
Sept. 14—	
Manistee	1
Mason County:	
Aug. 28–Oct. 29—	
Ludington	56
Oceana County:	
Sept. 8–19—	
Hart	2
Van Buren County:	
Aug. 1–Nov. 3—	
Bangor	4
Covert	5
Hartford	1
Lawrence	1
Lawton	1
McDonald	4
Paw Paw	3
South Haven	61
Washtenaw County:	
Oct.—	
Ann Arbor	1
Mich., State total	816

MINNESOTA.

	Cars.
Hennepin County:	
Aug.—	
Minneapolis	2
St. Louis County:	
Sept. 5—	
Duluth	1
Minn., State total	3

MISSOURI.

Buchanan County:	
Sept. 29–Oct. 6—	
St. Joseph	3
Clay County:	
Sept. 14—	
Liberty	1
Daviess County:	
Sept. 30–Oct. 13—	
Gallatin	4
Howell County:	
Oct. 20—	
Olden	1
Jackson County:	
Aug.—	
Kansas City	1
Lafayette County:	
Sept. 13–30—	
Lexington	3
Pike County:	
Sept. 24–Oct. 28—	
Louisiana	10
Mo., State total	23

NEBRASKA.

Buffalo County:	
Oct. 20—	
Kearney	1
Douglas County:	
Sept. 25–Oct. 30—	
Omaha	7
Frontier County:	
Oct. —	
Eustis	1
Lancaster County:	
Oct. 6—	
Lincoln	1
Nemaha County:	
Oct.—	
Brownville	2
Redwillow County:	
Oct.—	
Lebanon	1
Nebr., State total	13

NEW JERSEY.

Atlantic County:	
Oct. 16–25—	
Cologne	4
Magnolia	2
Bergen County:	
Nov. —	
Little Ferry	1
Burlington County:	
Aug. 11–Nov. 7—	
Beverly	36
Edgewater Park	15
Maple Shade	9
Marlton	1
Mount Holly	15
Riverton	62
Stevens	7
West Moorestown	14
Camden County:	
Aug. 11–Nov. 16—	
Merchantville	47
Mount Ephraim	9

DECIDUOUS FRUITS—Continued.

Table 6.—PEARS—Continued.

NEW JERSEY—Continued.

	Cars.
Cumberland County:	
Aug.—	
Greenwich	5
Vineland	10
Gloucester County:	
Sept. 14–Nov. 4—	
Woodbury	16
Hunterdon County:	
Sept. 20–Nov. 8—	
Flemington	3
Pittstown	7
Mercer County:	
Oct. 7–Nov. 11—	
Titusville	3
Trenton Junction	2
Windsor	1
Middlesex County:	
Oct.—	
Prospect Plains	2
Monmouth County:	
Sept.—	
Red Bank	13
N. J., State total	284

NEW MEXICO.

Dona Ana County:	
Aug. 5–7—	
Las Cruces	11
N. Mex., State total	11

NEW YORK.

Albany County:	
Aug. 1–Sept. 18—	
Albany	40
Coeymans	2
Cayuga County:	
Sept.–Oct.—	
Cayuga	1
Crockett	13
Kings Ferry	7
Sterling	1
Chautauqua County:	
Sept.—	
Brocton	1
Chemung County:	
Sept. 29–Oct. 17—	
Elmira	2
Columbia County:	
Aug.–Dec.—	
Cheviot	62
East Chatham	4
Germantown	139
Greendale	10
Hudson	130
Hudson Upper	4
Linlithgo	83
Newton Hook	1
Niverville	3
Stockport	40
Stuyvesant Falls	1
Dutchess County:	
Aug.–Oct.—	
Cokertown	2
Red Hook	1
Rhinecliff	2
Tivoli	5
Erie County:	
Aug. 28–Nov. 8—	
Akron Falls	1
Buffalo	1
Genesee County:	
Aug.–Sept.—	
Batavia	2
East Bethany	2
Elba	1
Le Roy	8
Oakfield	7

NEW YORK—Continued.

	Cars.
Greene County:	
Aug. 9–Nov. 26—	
Athens	59
Catskill	127
Coxsackie	132
New Baltimore	4
West Athens	7
Jefferson County:	
Aug.—	
Watertown	1
Livingston County:	
Oct. 24—	
Linwood	1
Monroe County:	
Aug.–Dec.—	
Brighton	24
Brockport	6
Elm Grove	1
Greece	3
Hamlin	10
Hilton	30
Morton	6
Pittsford	1
Rochester	47
Spencerport	7
Walker	8
Webster	14
New York County:	
Oct. 17–Nov.—	
New York	5
Niagara County:	
Sept.–Dec.—	
Appleton	4
Barker	60
Burt	23
Elberta	5
Gasport	29
La Salle	5
Lewiston	28
Lockport	103
Middleport	26
Model City	16
Newfane	6
Niagara Falls	1
Ransomville	16
Sanborn	1
Wilson	20
Onondaga County:	
Sept.–Oct. 30—	
Syracuse	5
Ontario County:	
Aug.–Nov. 25—	
Aloquin	2
Canandaigua	6
Geneva	3
Gorham	3
Hall	37
Holcomb	4
Naples	3
Oak Corners	1
Phelps	5
Seneca Castle	2
Victor	1
Orange County:	
Aug. 15–Sept. 15—	
Pine Island	2
Orleans County:	
Aug.–Dec.—	
Albion	26
Ashwood	7
Brice	6
Carlton	17
Fancher	2
Holley	6
Kendall	11
Knowlesville	3
Lyndonville	37
Medina	71
Millers	8
Waterport	21

NEW YORK—Continued.

	Cars.
Oswego County:	
Aug.–Nov.—	
Furniss	10
Hannibal	11
Oswego	66
Scriba	5
Rensselaer County:	
Sept.–Nov.—	
Castleton	1
Rensselaer	3
Schodack	32
Troy	2
Van Hoesen	1
Schenectady County:	
Nov.—	
Aqueduct	1
Schuyler County:	
Sept. 6–Oct. 21—	
Hector	1
Odessa	1
Seneca County:	
Sept. 5–13—	
Interlaken	2
Kendaia	3
Seneca Falls	3
Yale	1
Suffolk County:	
Oct. 30—	
Northport	1
Tompkins County:	
Aug.—	
Ithaca	2
Ulster County:	
Aug.–Nov.—	
Clintondale	1
Esopus	1
Highland	5
Loyd	1
Marlboro	17
Milton	20
Ulster Park	1
Wayne County:	
Aug.–Oct.—	
Clyde	14
East Williamson	1
Fruitland	6
Lyons	17
Marion	2
Newark	1
North Rose	5
Ontario	3
Red Creek	6
Savannah	1
Sodus	4
Walworth	7
Williamson	18
Wolcott	3
Westchester County:	
Sept.–Oct.—	
Croton Falls	3
Millwood	3
Wyoming County:	
Sept. 8—	
Pearl Creek	1
Yates County:	
Aug. 31–Nov. 22—	
Bellona	10
Branchport	3
Glenora	1
Middlesex	5
Penn Yan	10
Rock Stream	1
Rushville	1
Starkey	9
N. Y. State total	2,028

OHIO.

Erie County:	
Sept. 23–Nov. 1—	
Berlin Heights	14
Castalia	1

DECIDUOUS FRUITS—Continued.

Table 6.—PEARS—Continued.

OHIO—Continued.

	Cars.
Franklin County:	
Sept. 1–14—	
Columbus	1
Geauga County:	
Sept. 1–14—	
East Claridon	6
Lake County:	
Oct. 9—	
Painesville	1
Ottawa County:	
Aug. 16–Oct.—	
Danbury	11
Elmore	2
Gypsum	7
La Carne	4
Oak Harbor	3
Port Clinton	6
Sandusky County:	
Oct. 6–Nov. 2—	
Clyde	15
Shelby County:	
Nov. 2—	
Kirkwood	1
Stark County:	
Oct.—	
Greentown	1
Ohio, State total	73

OREGON.

Douglas County:	
Aug. 12–31—	
Dillard	20
Riddle	1
Roseburg	10
Hood River County—	
Aug. 24–Nov. 6—	
Hood River	92
Jackson County:	
Aug. 4–Oct. 29—	
Ashland	2
Central Point	22
Gold Hill	6
Medford	390
Phoenix	54
Rogue River	2
Talent	7
Josephine County:	
Aug. 12–Dec. 28—	
Grants Pass	17
Marion County:	
Aug. 22–Oct. 10—	
Salem	11
Multnomah County:	
Aug. 13–Sept. 18—	
Albina	1
Portland	1
Umatilla County:	
Sept. 6–Nov. 1—	
Milton	5
Wasco County:	
Aug. 24–Oct. 31—	
Mosier	3
The Dalles	3
Washington County:	
Aug. 19—	
Sherwood	1
Oreg., State total	648

PENNSYLVANIA.

Chester County:	
Sept. 28–Nov. 1—	
Atglen	22
Kelton	1
Cumberland County:	
Sept.—	
Gardners	2

PENNSYLVANIA—Contd.

	Cars.
Lackawanna County:	
Oct.—	
Scranton	11
Philadelphia County:	
Nov.–Dec.—	
Philadelphia	14
Snyder County:	
Nov. 3—	
Selinsgrove	1
Pa., State total	51

SOUTH DAKOTA.

Brown County:	
Oct. 23—	
Aberdeen	1
S. Dak., State total	1

TENNESSEE.

Davidson County:	
July 12—	
Nashville	1
Tenn., State total	1

TEXAS.

Anderson County:	
Sept. 12–Oct. 14—	
Palestine	2
Bowie County:	
Aug.—	
Maud	1
Cherokee County:	
Aug. 1–20—	
Mt. Selman	7
Comanche County:	
Aug. 15—	
De Leon	1
Cooke County:	
Sept.—	
Gainesville	4
Woodbine	2
Dallas County:	
Aug. 30—	
Kleburg	1
Seagoville	1
Denton County:	
Sept. 10–27—	
Denton	3
Pilot Point	7
Eastland County:	
Aug. 25—	
Gorman	1
El Paso County:	
July 27–Oct. 5—	
Clint	20
Ysleta	40
Gregg County:	
Aug. 26—	
Scottsville	1
Hill County:	
Aug. 31—	
Covington	1
Lamar County:	
Aug. 17—	
Paris	1
Limestone County:	
Nov. 11—	
Fallon	1
Montague County:	
July 6—	
Bowie	1
Morris County:	
Aug.—	
Naples	1
Smith County:	
Aug. 15–17—	
Swan	3

TEXAS—Continued.

	Cars.
Wise County:	
July 26–Aug. 31—	
Alvord	1
Decatur	4
Tex., State total	104

UTAH.

Grand County:	
Oct. 1–7—	
Thompsons	2
Salt Lake County:	
Aug. 31—	
Salt Lake City	1
Utah County:	
Aug. 23–Sept. 16—	
Provo	21
Utah, State total	24

VIRGINIA.

Norfolk County:	
Oct. 29—	
Norfolk	1
Shenandoah County:	
Sept. 21—	
Fishers Hill	1
Va., State total	2

WASHINGTON.

Benton County:	
Aug. 1–Dec. 15—	
Benton	2
Hanford	8
Kennewick	41
North Prosser	18
Prosser	5
White Bluffs	2
Chelan County:	
Aug. 4–Oct. 19—	
Cashmere	73
Chelan	1
Entiat	29
Wenatchee	226
Douglas County:	
Sept. 29—	
Columbia River	1
Grant County:	
Aug. 25–31—	
Coulee City	4
King County:	
Sept. 7–19—	
Seattle	3
Kittitas County:	
Oct. 26—	
White Salmon	1
Lincoln County:	
Aug. 23–Oct. 9—	
Creston	6
Davenport	2
Wilbur	1
Okanogan County:	
Aug. 19–Sept. 12—	
Brewster	2
Okanogan	3
Omak	3
Pateros	5
Spokane County:	
Sept. 24–Oct. 18—	
Dishman	2
Spokane	2
Yardley	3
Stevens County:	
Sept. 11–Nov. 4—	
Meyers Falls	4

DECIDUOUS FRUITS—Continued.

Table 6.—PEARS—Continued.

WASHINGTON—Continued.

	Cars.
Walla Walla County:	
Aug. 8–Oct. 23—	
Walker	3
Walla Walla	1
Wallula	4
Whitman County:	
Aug. 13–Oct. 24—	
Almota	3
Bishop	3
Palouse	1
Riparia	1
Yakima County:	
Aug.–Jan.—	
Clark	9
Clift	2
Congdon	2
Donald	92
Exchange	6
Gore	1
Grandview	20

WASHINGTON—Continued.

	Cars.
Yakima County—Contd.	
Aug.—Jan.—	
Granger	14
Morgans	1
North Yakima	846
Orchard	13
Parker	4
Selah	91
Shannon	10
Stewart	4
Sunnyside	3
Taylor	2
Toppenish	11
Wapato	30
Wiley City	4
Wright	1
Zillah	275
Wash., State total	1,904

WEST VIRGINIA.

	Cars.
Berkeley County:	
Aug. 23—	
North Mountain	1
W. Va., State total	1

WISCONSIN.

Milwaukee County:	
Sept. 23–Dec. 30—	
Milwaukee	2
Washburn County:	
Oct.—	
Spooner	1
Wis., State total	3

Table 7.—PLUMS.

CALIFORNIA.

	Cars.
Contra Costa County:	
June 21–26—	
Concord	3
Fresno County:	
July 26—	
Lone Star	1
Kings County:	
June–July—	
Hanford	6
Los Angeles County:	
July 14–Aug. 12—	
Los Angeles	3
Pomona	2
Orange County:	
July 11—	
Anaheim	1
Riverside County:	
July 22–27—	
Banning	4
Solano County:	
June—	
Fairfield	2
Tulare County:	
May 30–Aug. 2—	
Cutler	10
North Dinuba	2
Seville	5
Tulare	4
Cal., State total	43

MARYLAND.

Baltimore City:	
Sept. 30–Oct. 9—	
Baltimore	2
Md., State total	2

MICHIGAN.

Benzie County:	
Sept. 2–19—	
Frankfort	2
Grand Traverse County:	
Sept. 5–Oct. 8—	
Traverse City	12
Kent County:	
Sept.–Oct.—	
Grand Rapids	2
Manistee County:	
Sept. 4–Oct. 4—	
Arcadia	1
Onekama	2

MICHIGAN—Continued.

	Cars.
Mason County:	
Aug. 22–Oct. 6—	
Ludington	44
Muskegon County:	
Sept. 10—	
Whitehall	1
Oceana County:	
Sept. 5–Oct. 4—	
Hart	70
Pentwater	1
Shelby	12
Mich., State total	147

NEBRASKA.

Hall County:	
Sept.—	
Grand Island	1
Nebr., State total	1

NEW YORK.

Erie County:	
Aug. 28–Sept. 9—	
Buffalo	1
Niagara County:	
Sept.–Oct.—	
Barker	1
Lewiston	27
Lockport	5
Orleans County:	
Oct.—	
Millers	1
Waterport	1
Yates County:	
Sept. 8–29—	
Branchport	2
Middlesex	1
Penn Yan	2
N. Y., State total	41

OHIO.

Ottawa County:	
Aug. 16–31—	
Danbury	3
La Carne	1
Oak Harbor	1
Ohio, State total	5

OREGON.

	Cars.
Umatilla County:	
July 22–Aug. 22—	
Freewater	1
Milton	2
Oreg., State total	3

PENNSYLVANIA.

Philadelphia County:	
Aug.—	
Philadelphia	3
Pa., State total	3

TEXAS.

Tarrant County:	
June 25—	
Fort Worth	1
Tex., State total	1

VIRGINIA.

Frederick County:	
Aug. 10–11—	
Winchester	1
Shenandoah County:	
Aug. 16–18—	
Toms Brook	1
Woodstock	1
Va., State total	3

WASHINGTON.

Chelan County:	
Aug. 2–Sept. 23—	
Cashmere	3
Wenatchee	9
Whitman County:	
July 20–Sept. 14—	
Almota	13
Bishop	4
Wash., State total	29

WEST VIRGINIA.

Hampshire County:	
Aug. 15—	
Romney	1
Morgan County:	
Aug.—	
Paw Paw	1
W. Va., State total	2

DECIDUOUS FRUITS—Continued.

Table 8.—FRESH PRUNES.

CALIFORNIA.	Cars.
Fresno County:	
July 20–Oct. 10—	
Del Rey	1
Parlier	1
Reedley	1
Los Angeles County:	
July 8–Aug. 31—	
Arcadia	2
Los Angeles	1
Sonoma County:	
Oct. 23–Dec. 22—	
Sebastopol	2
Tehama County:	
Oct. 23–Nov. 29—	
Red Bluff	2
Cal., State total	10
COLORADO.	
Garfield County:	
Oct.—	
Grand Valley	1
Colo., State total	1
IDAHO.	
Latah County:	
Sept. 24–Oct. 4—	
Juliaetta	2
Kendrick	3
Moscow	1
Idaho, State total	6
NEW YORK.	
Livingston County:	
Sept. 20—	
Avon	2
Niagara County:	
Oct.—	
Lockport	1
N. Y., State total	3

OREGON.	Cars.
Lane County:	
Sept. 3–29—	
Eugene	13
Marion County:	
Nov. 23—	
Salem	1
Polk County:	
Sept. 8–13—	
Dallas	4
Umatilla County:	
Aug. 13–22—	
Freewater	3
Milton	119
Union County:	
Sept. 29–Oct.—	
Cove	36
La Grande	1
Union	29
Union Junction	1
Wasco County:	
Aug. 26–Dec. 4—	
Mosier	10
The Dalles	25
Yamhill County:	
Sept. 11–13—	
Dundee	3
Oreg., State total	245
PENNSYLVANIA.	
Erie County:	
Sept.—	
North East	3
Pa., State total	3
UTAH.	
Utah County:	
Sept. 5–22—	
Provo	9
Utah, State total	9

WASHINGTON.	Cars.
Chelan County:	
Sept. 5–24—	
Cashmere	2
Wenatchee	19
Clarke County:	
Oct. 7–13—	
Vancouver	20
Spokane County:	
Sept. 26–Oct. 10—	
Fairfield	1
Spokane	2
Yardley	2
Stevens County:	
Sept. 18–26—	
Meyers Falls	2
Walla Walla County:	
Aug. 22–Oct. 19—	
Barrett	1
Touchet	2
Walla Walla	217
Whitman County:	
Oct. 5–13—	
Elberton	8
Farmington	1
Yakima County:	
Aug. 19–Sept. 21—	
Clift	1
Donald	10
Flint	6
North Yakima	9
Selah	1
Zillah	17
Wash., State total	321

Table 9.—QUINCES.

CALIFORNIA.	Cars.
Los Angeles County:	
Sept. 10—	
Newmark	1
Riverside County:	
Oct.—	
Riverside	2
Cal., State total	3
LOUISIANA.	
Orleans Parish:	
Oct. 14—	
New Orleans	1
La., State total	1
MARYLAND.	
Baltimore City:	
Oct. 25—	
Baltimore	1
Md., State total	1

MICHIGAN.	Cars.
Mason County:	
Oct. 4–15—	
Ludington	1
Mich., State total	1
NEW YORK.	
Monroe County:	
Oct. 1–15—	
Webster	1
Niagara County:	
Oct. 1–15—	
Lockport	1
Newfane	1
Wilson	2
Orleans County:	
Oct. 1–15—	
Albion	2
Yates County:	
Oct. 17—	
Penn Yan	1
N. Y., State total	8

PENNSYLVANIA.	Cars.
Philadelphia County:	
Oct.—	
Philadelphia	1
Pa., State total	1
VIRGINIA.	
Norfolk County:	
July—	
Norfolk	1
Va., State total	1

DECIDUOUS FRUITS—Continued.

Table 10.—MIXED FRUIT.

CALIFORNIA.

	Cars.
Alameda County:	
May 31–Nov. 3—	
Alvarado	1
Hayward	8
Lorenzo	28
Niles	3
Oakdale	1
Oakland	12
Butte County:	
June 15–Sept. 28—	
Biggs	3
Chico	1
East Gridley	8
Paradise	7
Rio Bonito	1
Colusa County:	
Aug. 9–Sept. 11—	
Arbuckle	11
Contra Costa County:	
June 12–Dec. 2—	
Antioch	3
Concord	107
Danville	11
Martinez	2
Oakley	7
Rady	17
Whitman	6
Eldorado County:	
July 19–Oct. 4—	
Diamond Springs	3
Placerville	198
Fresno County:	
June 11–Nov. 19—	
Calwa	11
Caruthers	12
Chimanti	9
Clovis	553
Coneio	2
Del Rey	18
East Fresno	75
Fowler	156
Fresno	403
Kerman	36
Kingsburg	41
Las Palmas	138
Laton	1
Lone Star	1
Malaga	1
Minkler	1
Parlier	39
Reedley	57
Sanger	709
Selma	150
Kern County:	
May 22–Aug. 26—	
Famoso	10
Gosford	1
McFarland	8
Kings County:	
June 8–Oct. 25—	
Armona	63
Hardwick	7
Hanford	34
Lemoore	3
Los Angeles County:	
Jan. 5–Dec. 30—	
Clements	6
Glendale	2
Lankershim	2
Los Angeles	234
Pacoima	1
Palmdale	3
Pomona	1
San Dimas	3
Vernondale	1
Madera County:	
Aug. 12–Oct. 25—	
Madera	26
Marin County:	
June 24–Aug. 3—	
Highland	1
Reed	40

CALIFORNIA—Continued.

	Cars.
Mendocino County:	
Aug. 3–Oct. 13—	
Hopland	4
Ukiah	5
Merced County:	
July 16–Nov. 4—	
Atwater	145
Livingston	213
Monterey County:	
Sept. 15–Oct. 14—	
Monterey	6
Napa County:	
June 24–Sept. 20—	
Napa	2
Orange County:	
June 17–Oct. 13—	
Des Moines	1
Fullerton	1
Placer County:	
June 5–Oct. 2—	
Auburn	168
Colfax	119
Lincoln	21
Loomis	605
Newcastle	1,503
Penryn	345
Roseville	10
Riverside County:	
Feb. 15–Sept. 21—	
Banning	11
Beaumont	7
Bowers	1
Corona	1
Prenda	1
Sacramento County:	
Jan. 8–Nov. 17—	
Alden	26
Bradford	6
Bradshaw	16
Brighton	36
Coffing	22
Elk Grove	91
Fair Oaks	3
Florin	244
Florin Road	2
Folsom	187
Galt	72
Glannvale	7
Hood	115
Mayhews	49
Sacramento	1,267
Sheldon	5
Valensin	1
Walnut Grove	58
San Benito County:	
July 19–Oct. 23—	
Aromas	23
Hollister	4
San Bernardino County:	
Mar. 3–Oct. 12—	
Bloomington	2
Cucamonga	2
Joyce	4
Upland	1
San Diego County:	
June 10—	
Escondido	1
San Francisco County:	
June 5–Dec. 27—	
San Francisco	46
San Joaquin County:	
May 13–Nov. 22—	
Acampo	325
Ampere	18
Calla	19
Castle	14
Escalon	90
Hammer	1
Kenefick	2
Kingdon	17
Lathrop	1
Linden	1
Lockford	10

CALIFORNIA—Continued.

	Cars.
San Joaquin County—Con.	
May 13–Nov. 22—	
Lodi	2,549
Manteca	2
Mettler	10
Meyers	7
Pearson	2
Peters	3
Ripon	20
Stockton	185
Thornton	29
Weston	1
Youngstown	5
San Luis Obispo County:	
July 22–Aug. 5—	
Paso Robles	5
San Miguel	1
San Mateo County:	
Oct. 31—	
Colma	1
Santa Barbara County:	
Oct. 4—	
Ellwood	1
Santa Barbara	1
Santa Clara County:	
May 10–Nov. 16—	
Alviso	137
Lawrence	1
Morganhill	2
San Jose	158
Santa Clara	128
Sargent	35
Wayne	5
Santa Cruz County:	
July 6–Sept. 22—	
Santa Cruz	3
Watsonville	8
Shasta County:	
July 20–Sept. 22—	
Anderson	11
Cottonwood	23
Sims	1
Siskiyou County:	
Aug. 28–Nov. 17—	
Hilt	1
Sisson	1
Solano County:	
May 4–Oct. 23—	
Boynton	1
Cordelia	113
Danielson	303
Suisun	55
Vacaville	1,214
Willotta	230
Sonoma County:	
July 10–Nov. 18—	
McGill	1
Sebastopol	8
Shellville Junction	16
Vineburg	1
Wright	20
Stanislaus County:	
July 18–Nov. 15—	
Aurora	2
Ceres	155
Denair	1
Gilman	2
Keyes	36
Modesto	24
Salida	20
Turlock	115
Sutter County:	
July 23–Oct. 16—	
Live Oak	1
Stafford	1
Yuba City	41
Tehama County:	
June 6–Sept. 10—	
Corning	233
Los Molinos	2
Red Bluff	39

DECIDUOUS FRUITS—Continued.

Table 10.—MIXED FRUIT—Continued.

CALIFORNIA—Continued.	Cars.
Tulare County:	
Jan. 5–Nov. 26—	
Baier	5
Cutler	61
Dinuba	446
Exeter	210
Farmersville	32
Farmington	38
Lindsay	7
North Dinuba	13
Porterville	21
Seville	4
Strathmore	1
Sultana	3
Tulare	3
Visalia	52
Woodlake	17
Yolo County:	
May 18–Nov. 10—	
Davis	1
Guinda	21
Knights Landing	31
Madison	1
Norton	6
Rose Orchard	22
Winters	413
Woodland	3
Yuba County:	
June 10–Oct. 21—	
Marysville	43
Wheatland	1
Cal., State total	16,679

COLORADO.	
Delta County:	
Sept. 1–Nov. 1—	
Austin	15
Denver County:	
Sept. 19–23—	
Denver	2
Fremont County:	
July 11—	
Canon City	1
Mesa County:	
July 22–Sept. 6—	
Clifton	3
Palisade	83
Colo., State total	104

DELAWARE.	
Kent County:	
Aug. 17—	
Wyoming	3
Del., State total	3

FLORIDA.	
Hillsborough County:	
Jan. 1–Dec. 31—	
Thonotasassa	5
Manatee County:	
Jan. 1–Dec. 31—	
Ellenton	20
Fla., State total	25

GEORGIA.	
Fulton County:	
June 30—	
Atlanta	1
Ga., State total	1

IDAHO.	Cars.
Latah County:	
Sept. 10—	
Kendrick	2
Nez Perce County:	
July 9–Oct. 18—	
Lewiston	81
Idaho, State total	83

ILLINOIS.	
Cook County:	
Jan. 5–Dec. 27—	
Chicago	28
Marion County:	
Aug. 26—	
Centralia	1
Sandoval	1
Ill., State total	30

INDIANA.	
Dekalb County:	
Nov.–Dec.—	
Auburn	1
Waterloo	1
Ind., State total	2

IOWA.	
Johnson County:	
Apr. 8—	
River Junction	1
Scott County:	
June–Aug. 11—	
Davenport	5
Wapello County:	
Jan. 1–Dec. 31—	
Ottumwa	17
Iowa, State total	23

KANSAS.	
Shawnee County:	
July 1–Dec. 9—	
Topeka	2
Kans., State total	2

LOUISIANA.	
Orleans Parish:	
May 17–Dec. 18—	
New Orleans	107
La., State total	107

MARYLAND.	
Baltimore City:	
May 8–Dec. 23—	
Baltimore	18
Md., State total	18

MASSACHUSETTS.	
Suffolk County:	
Oct. 21–Dec. 18—	
Boston	11
Mass., State total	11

MICHIGAN.	
Benzie County:	
Sept. 16–23—	
Frankfort	3

MICHIGAN—Continued.	Cars.
Berrien County:	
Aug. 11—	
Benton Harbor	1
Grand Traverse County:	
Sept. 9–Oct. 3—	
Traverse City	2
Hillsdale County:	
Nov.—	
Hillsdale	1
Oceana County:	
Aug. 21–Sept. 26—	
Mears	1
Shelby	5
Ottawa County:	
July 10–17—	
Holland	7
Mich., State total	20

MINNESOTA.	
Hennepin County:	
Sept.—	
Minneapolis	52
Ramsey County:	
Sept. 9—	
St. Paul	1
Minn., State total	53

MISSOURI.	
Perry County:	
Sept. 13–Oct. 1—	
Seventy-Six	8
St. Louis City:	
June 29–July 24—	
St. Louis	2
Mo., State total	10

MONTANA.	
Yellowstone County:	
Feb. 26–Sept. 11—	
Billings	14
Mont., State total	14

NEBRASKA.	
Douglas County:	
June 3–23—	
Omaha	2
Nebr., State total	2

NEW YORK.	
Albany County:	
Oct.–Dec.—	
Albany	3
Feura Bush	2
Bronx County:	
Oct.–Nov.—	
St. Johns Park	1
Broome County:	
Oct. 24—	
Binghamton	1
Cayuga County:	
Sept.—	
Crockett	1
Columbia County:	
Aug.–Dec.—	
Germantown	43
Hudson	6
Linlithgo	5
Erie County:	
Nov.–Dec.—	
Buffalo	1
Crittendon	1

DECIDUOUS FRUITS—Continued.

Table 10.—MIXED FRUIT—Continued.

NEW YORK—Continued.

	Cars.
Genesee County:	
Oct.-Dec.—	
Le Roy	2
Greene County:	
Oct.—	
Coxsackie	2
Livingston County:	
Sept. 27—	
Linwood	1
Monroe County:	
Aug.-Dec.—	
Brockport	4
Elm Grove	1
Hamlin	23
Hilton	28
Morton	3
Pittsford	1
Rochester	3
Spencerport	7
Union Hill	1
Webster	4
New York County:	
Oct.—	
New York	1
Niagara County:	
Aug.-Dec.—	
Appleton	5
Barker	19
Burt	8
Gasport	10
Lewiston	73
Lockport	48
Middleport	31
Model City	2
Newfane	1
Ransomville	1
Sanborn	1
Wilson	5
Onondaga County:	
July 17-Aug. 22—	
Syracuse	3
Ontario County:	
Sept. 13-Oct.—	
Geneva	1
Gorham	1
Holcomb	1
Naples	1
Phelps	2
Orleans County:	
Aug.-Dec.—	
Albion	17
Ashwood	4
Brice	3
Carlton	4
Fancher	3
Holley	4
Kendall	9
Knowlesville	2
Lyndonville	91
Medina	18
Millers	6
Waterport	2
Oswego County:	
Oct.-Nov.—	
Hannibal	1
Oswego	1
Rensselaer County:	
Sept.-Oct.—	
Schodack	11
Seneca County:	
Sept. 21-30—	
Junius	1
Seneca Falls	2
Waterloo	1
Steuben County:	
Oct. 31—	
Corning	1
Ulster County:	
July 28—	
Marlboro	1
Ulster Park	1

NEW YORK—Continued.

	Cars.
Wayne County:	
Sept.-Dec.—	
Clyde	5
East Williamson	9
Fruitland	10
Lyons	7
North Rose	5
Ontario	13
Red Creek	5
Sodus	13
Walworth	2
Williamson	23
Wolcott	4
Yates County:	
Sept. 1-Oct. 19—	
Bellona	1
Branchport	1
Middlesex	2
Penn Yan	35
N. Y., State total	676

NORTH CAROLINA.

Wayne County:	
June 30—	
Mount Olive	1
N. C., State total	1

OHIO.

Cuyahoga County:	
June 12-Dec. 29—	
Cleveland	30
Cleveland Pier	1
Franklin County:	
Jan. 1-Dec. 31—	
Columbus	197
Hamilton County:	
June 21-Dec. 4—	
Cincinnati	12
Huron County:	
Nov.—	
Wakeman	1
Ottawa County:	
Aug. 16-Sept.—	
Danbury	1
Gypsum	1
La Carne	7
Oak Harbor	1
Ohio, State total	251

OREGON.

Jackson County:	
Aug. 15-Nov. 8—	
Medford	2
Talent	1
Marion County:	
Aug. 12-Dec. 23—	
Salem	2
Multnomah County:	
May 2-Dec. 22—	
East Portland	48
Portland	2
Umatilla County:	
July 26-Aug. 19—	
Freewater	2
Milton	8
Wasco County:	
July 26-Aug. 30—	
The Dalles	3
Oreg., State total	68

PENNSYLVANIA.

	Cars.
Berks County:	
July 20—	
Reading	1
Erie County:	
July 14—	
North East	6
Franklin County:	
May 6—	
Midvale	1
Pa., State total	8

SOUTH DAKOTA.

Minnehaha County:	
May 3—	
Sioux Falls	1
S. Dak., State total	1

TEXAS.

Dallas County:	
Feb. 25-Dec. 24—	
Dallas	16
Wood County:	
Feb.—	
Winnsboro	6
Tex., State total	22

UTAH.

Salt Lake County:	
Aug. 2-22—	
Salt Lake City	3
Weber County:	
Sept. 14-Dec. 16—	
Ogden	4
Utah, State total	7

VIRGINIA.

Henrico County:	
Sept. 7—	
Richmond	1
Va., State total	1

WASHINGTON.

Benton County:	
July 19-Nov. 23—	
Benton	3
Kennewick	34
Prosser	37
Chelan County:	
Aug. 15-Sept. 16—	
Cashmere	17
Wenatchee	7
Columbia County:	
Aug. 19—	
Starbuck	1
King County:	
Oct. 31-Nov. 1—	
Seattle	2
Lincoln County:	
Aug. 16-Oct. 14—	
Creston	31
Okanogan County:	
Sept. 16-Sept. 19—	
Okanogan	2
Spokane County:	
Jan. 1-Nov. 20—	
Spokane	14
Walla Walla County:	
July 29-Sept. 11—	
Walla Walla	9
Wallula	3

DECIDUOUS FRUITS—Continued.

Table 10.—MIXED FRUIT—Continued.

WASHINGTON—Continued.

	Cars.
Whitman County:	
July 13–Sept. 26—	
Almota	2
Bishop	35
Garfield	1
Wawawai	1
Yakima County:	
Jan. 1–Dec. 17—	
Buena	2
Cutler	1
Donald	29
Flint	3
Grandview	27
North Yakima	656
Parker	3
Sawyer	4
Selah	9
Sunnyside	2

WASHINGTON—Continued.

	Cars.
Yakima County—Contd.	
Jan. 1–Dec. 17—	
Wapato	33
Zillah	160
Wash., State total	1,128

WEST VIRGINIA.

Hampshire County:	
Aug. 3–Sept. 12—	
Romney	10
Wood County:	
July 31–Aug. 29—	
Parkersburg	3
W. Va., State total	13

WISCONSIN.

	Cars.
Winnebago County:	
Mar. 22–July 27—	
Oshkosh	3
Wis., State total	3

WYOMING.

Albany County:	
June 14–27—	
Laramie	1
Wyo., State total	1

DRIED FRUITS.

Table 11.—DRIED APPLES.

ARKANSAS.

	Cars.
Benton County:	
Oct. 7–Dec. 16—	
Avoca	3
Bentonville	5
Cave Springs	1
Decatur	2
Gentry	2
Rogers	1
Siloam Springs	1
Washington County:	
May 1–Dec. 30—	
Fayetteville	50
Lincoln	6
Springdale	5
Ark., State total	76

CALIFORNIA.

San Francisco County:	
Nov. 26—	
San Francisco	1
Sonoma County:	
July 3–Nov. 10—	
Sebastopol	16
Cal., State total	17

ILLINOIS.

Clay County:	
Aug. 15–Dec. 1—	
Xenia	4
Greene County:	
Oct. 11–31—	
Hillview	4
Marion County:	
Apr. 6–Sept. 1—	
Salem	5
Richland County:	
Feb. 1–Oct. 18—	
Noble	1
Olney	3
St. Clair County:	
Jan. 9—	
Broadway	1
Wayne County:	
Aug.–Oct.—	
Geff	5
Ill., State total	23

INDIANA.

	Cars.
Dekalb County:	
Dec.—	
Waterloo	1
Ind., State total	1

MARYLAND.

Frederick County:	
Nov. 4.–14—	
Lewistown	2
Md., State total	2

MICHIGAN.

Grand Traverse County:	
Nov. 26—	
Traverse City	2
Jackson County:	
Sept.–Nov.—	
Springport	6
Monroe County:	
Dec.—	
Dundee	1
Mich., State total	9

MINNESOTA.

Hennepin County:	
May 27—	
Minneapolis	1
Minn., State total	1

MISSOURI.

McDonald County:	
May 16—	
Lanagan	1
St. Louis City:	
May 9–Oct. 6—	
St. Louis	2
Mo., State total	3

NEW YORK.

Allegany County:	
Apr. 1–Dec. 31—	
Rossburg	2
Whitesville	6

NEW YORK—Continued.

	Cars.
Bronx County:	
Oct.—	
St. Johns Park	1
Cattaraugus County:	
Aug. 15–Dec. 31—	
Cattaraugus	2
Conewango	2
Cayuga County:	
Oct.–Dec.—	
Cayuga	1
Crockett	1
Merrifield	2
Montezuma	1
North Port Byron	2
Sterling	1
Chemung County:	
Jan. 1–Dec. 31—	
Elmira	3
Erie County:	
Nov. 4—	
Buffalo	1
Genesee County:	
May 1–Dec.—	
Bergen	1
Byron	2
Le Roy	4
Livingston County:	
Jan. 9–Nov. 28—	
Conesus	1
Leicester	1
Monroe County:	
Jan. 29–Dec.—	
Adams Basin	1
Barnard	15
Brighton	11
Brockport	1
Charlotte	1
East Rochester	9
Elm Grove	1
Greece	3
Hamlin	3
Hilton	6
Honeoye Falls	2
Morton	2
Mumford	2
Pittsford	3
Rochester	83
Spencerport	1
Union Hill	5
Walker	1
Webster	8
New York County:	
Oct.–Dec.—	
New York	8

DRIED FRUITS—Continued.

Table 11.—DRIED APPLES—Continued.

NEW YORK—Continued.

	Cars.
Niagara County:	
Oct.–Dec.—	
Appleton	1
Barker	13
Burt	10
Elberta	2
Gasport	8
Lewiston	2
Lockport	3
Middleport	1
Ransomville	3
Ontario County:	
June 3–Dec.—	
Canandaigua	15
Geneva	1
Hall	7
Ionia	1
Naples	4
Oaks Corners	1
Orleans	1
Phelps	5
Seneca Castle	2
Shortsville	3
Stanley	4
Orleans County:	
Oct.–Dec.—	
Albion	1
Ashwood	5
Brice	5
Carlton	3
Eagle Harbor	4
Fancher	1
Holley	8
Kendall	3
Knowlesville	1
Lyndonville	8
Medina	37
Millers	5
Waterport	10
Oswego County:	
Nov.–Dec.—	
Hannibal	4
New Haven	2
Oswego	2
Scoharie County:	
Dec.—	
Cobleskill	5
Schuyler County:	
Oct. 26—	
Odessa	4
Seneca County:	
Nov.–Dec.—	
Hayts Corner	3
Ovid	4
Seneca Falls	6
Waterloo	1

NEW YORK—Continued.

	Cars.
Steuben County:	
Oct. 1–Dec. 30—	
Greenwood	5
Tompkins County:	
Mar. 31–Dec. 9—	
North Lansing	5
Ulster County:	
Dec.—	
Gardiner	1
Wayne County:	
Oct.–Dec.—	
Alton	35
Clyde	9
Fruitland	14
Lyons	1
North Rose	19
Ontario	5
Palmyra	2
Red Creek	26
Savannah	4
Sodus	38
South Palmyra	3
Wallington	2
Walworth	1
Williamson	25
Wolcott	13
Wyoming County:	
Mar. 25–Dec. 31—	
Pearl Creek	3
Perry	6
Wyoming	1
Yates County:	
Jan. 2–Dec. 21—	
Bellona	7
Branchport	6
Penn Yan	8
Rushville	19
N. Y., State total	667

NORTH CAROLINA.

Surry County:	
Sept. 9—	
Mt. Airy	1
N. C., State total	1

PENNSYLVANIA.

Adams County:	
May 17–Nov. 30—	
Bendersville	8
Biglerville	4

PENNSYLVANIA—Contd.

	Cars.
Armstrong County:	
Oct.–Nov.—	
Dayton	1
Franklin County:	
Oct. 26–Nov. 29—	
Greencastle	1
Mount Alto	2
Philadelphia County:	
May 17—	
Philadelphia	1
Pa., State total	17

TENNESSEE.

Johnson County:	
Oct.—	
Shouns	1
Tenn., State total	1

VERMONT.

Franklin County:	
Dec. 1—	
Saint Albans	5
Grand Isle County:	
June 19–Dec. 18—	
Grand Isle	2
Vt., State total	7

VIRGINIA.

Carroll County:	
Sept. 25–Dec. 12—	
Sylvatus	5
Frederick County:	
Oct. 4–Dec. 1—	
Stephens City	4
Winchester	9
Montgomery County:	
Oct. 2–Dec. 19—	
Christiansburg	3
Page County:	
Oct.—	
Stanley	5
Patrick County:	
Aug. 1–Dec. 30—	
Stuart	7
Roanoke County:	
Jan. 1–Dec. 30—	
East Roanoke	9
Rockingham County:	
Oct.—	
Elkton	1
Va., State total	43

Table 12.—DRIED APRICOTS.

CALIFORNIA.

	Cars.
Contra Costa County:	
July 25—	
Concord	1
Kings County:	
Sept.–Oct.—	
Hanford	6
Los Angeles County:	
Sept. 10–Nov. 4—	
Los Angeles	9
Orange County:	
Feb. 8—	
Santa Ana	1

CALIFORNIA—Continued.

	Cars.
San Francisco County:	
Nov. 26—	
San Francisco	2
Santa Clara County:	
Nov. 13—	
Milpitas	4
Cal., State total	23

NEW YORK.

	Cars.
New York County:	
Jan. 10–Nov. 21—	
New York	3
N. Y., State total	3

WASHINGTON.

Whitman County:	
July 14—	
Bishop	1
Wash., State total	1

DRIED FRUITS—Continued.

Table 13.—DRIED FIGS.

CALIFORNIA.

	Cars.
Fresno County:	
Aug. 26–Nov. 30—	
Del Rey	2
Fresno	35
Lone Star	1
Parlier	2
Reedley	1
San Francisco County:	
Nov. 11—	
San Francisco	1
Stanislaus County:	
July 1–Dec. 31—	
Modesto	1

CALIFORNIA—Continued.

	Cars.
Tulare County:	
Sept. 15–Oct. 30—	
Exeter	1
North Dinuba	3
Sultana	10
Cal., State total	57

NEW YORK.

New York County:	
Aug. 15–Oct. 31—	
New York	1

NEW YORK—Continued.

	Cars.
Richmond County:	
Oct. 27–30—	
St. George Lighterage	2
N. Y., State total	3

VIRGINIA.

New Kent County:	
Aug. 11–Sept. 8—	
Walkers	7
Va., State total	7

Table 14.—DRIED PEACHES.

CALIFORNIA.

	Cars.
Fresno County:	
Apr. 22–Dec. 31—	
Bowles	20
Del Rey	26
Fresno	19
Lone Star	3
Parlier	15
Reedley	12
Kings County:	
Jan. 1–Dec. 30—	
Hanford	20
Los Angeles County:	
Aug. 28—	
Los Angeles	1
San Francisco County:	
Jan. 15–Oct. 29—	
San Francisco	7

CALIFORNIA—Continued.

	Cars.
Santa Clara County:	
Nov. 24—	
San Jose	1
Stanislaus County:	
July 1–Dec. 31—	
Empire	2
Modesto	4
Tulare County:	
Apr. 22–Nov. 11—	
Cutler	21
Exeter	1
Yettem	1
Cal., State total	153

NEW JERSEY.

Cumberland County:	
Oct.—	
Vineland	1
N. J., State total	1

NEW YORK.

	Cars.
Monroe County:	
Aug.–Oct.—	
Hilton	56
New York County:	
Sept. 7–Nov. 8—	
New York	2
N. Y., State total	58

TEXAS.

Wood County:	
June–Dec.—	
Golden	4
Tex., State total	4

WASHINGTON.

Okanogan County:	
May 31—	
Brewster	1
Wash., State total	1

Table 15.—DRIED PEARS.

CALIFORNIA.

	Cars.
Sonoma County:	
Sept. 27—	
Sebastopol	1
Cal., State total	1

Table 16.—DRIED PRUNES.

ARIZONA.

	Cars.
Cochise County:	
July—	
Naco	2
Ariz., State total	2

CALIFORNIA.

Alameda County:	
Sept. 28—	
Oakland	1
Butte County:	
Nov. 7–22—	
Chico	9
Contra Costa County:	
Sept. 11–Oct. 13—	
Concord	15
Fresno County:	
Oct. 10–Dec. 14—	
Bowles	1
Fresno	1
Kern County:	
Oct. 10—	
Bakersfield	1
Kings County:	
July 15–Dec. 30—	
Hanford	51
Los Angeles County:	
Aug. 8–Nov. 26—	
Edenvale	16
Los Angeles	2
Napa County:	
Oct. 29–Nov. 4—	
Napa	7

CALIFORNIA—Continued.

Riverside County:	
Oct. 17—	
Banning	1
San Francisco County:	
Jan. 15–Dec. 22—	
San Francisco	25
Santa Clara County:	
July 25–Nov. 26—	
Gilroy	2
Los Gatos	23
Milpitas	12
San Jose	71
Santa Clara	26
San Tomas	2
Sunnyvale	5
Sonoma County:	
Sept. 18–Nov. 19—	
Healdsburg	8
Santa Rosa	14
Sebastopol	4
Tulare County:	
Nov. 13–Nov. 26—	
Tulare	2
Visalia	1
Cal., State total	300

MARYLAND.

Baltimore City:	
June 26—	
Baltimore	1
Md., State total	1

NEW JERSEY.

	Cars.
Hudson County:	
Dec. 31—	
Manhattan Piers	1
N. J., State total	1

NEW YORK.

New York County:	
Jan. 3–6—	
New York	2
Richmond County:	
Mar. 1—	
St. George Lighterage	2
N. Y., State total	4

OREGON.

Douglas County:	
Apr. 20–Oct. 10—	
Roseburg	13
Marion County:	
Nov. 15—	
Salem	1
Multnomah County:	
Jan. 4–Mar. 8—	
Portland	11
Oreg., State total	25

WASHINGTON.

Clarke County:	
Oct. 5–Nov. 27—	
Vancouver	48
Wash., State total	48

DRIED FRUITS—Continued.

Table 17.—RAISINS.

CALIFORNIA.

	Cars.
Alameda County:	
Jan. 22—	
Oakland	1
Fresno County:	
Jan. 1–Dec. 31—	
Bowles	24
Del Rey	661
Fresno	1,225
Laton	1
Lone Star	100
Minkler	24
Parlier	302
Reedley	117
Kern County:	
Dec. 30—	
Bakersfield	1
Madera County:	
Oct. 10–Nov. 7—	
Storey	8

CALIFORNIA—Continued.

	Cars.
San Bernardino County:	
Nov. 8–Dec. 22—	
Cucamonga	12
Devore	2
Etiwanda	12
San Diego County:	
Sept.–Dec.—	
El Cajon	21
Escondido	4
San Francisco County:	
Mar. 17–Oct. 5—	
San Francisco	5
Stanislaus County:	
July 1–Dec. 31—	
Keyes	1
Modesto	13
Sutter County:	
Oct. 23—	
Yuba City	1

CALIFORNIA—Continued.

	Cars.
Tulare County:	
Feb. 1–Dec. 31—	
Cutler	53
Dinuba	4
Exeter	7
North Dinuba	47
Orosi	3
Sultana	104
Yettem	101
Cal., State total	2,854

NEW YORK.

New York County:	
Jan. 29–Nov. 14—	
New York	6
N. Y., State total	6

Table 18.—DATES.

NEW JERSEY.

	Cars.
Hudson County:	
Jan. 4–Dec. 6—	
Manhattan Piers	7
N. J., State total	7

NEW YORK.

	Cars.
New York County:	
Jan. 8–Dec. 15—	
New York	9

NEW YORK—Continued.

	Cars.
Richmond County:	
Mar. 13–Dec. 5—	
American Dock Terminal	1
St. George Lighterage	4
N. Y., State total	14

Table 19.—MIXED DRIED FRUIT.

ARKANSAS.

	Cars.
Benton County:	
Oct. 7–Oct. 27—	
Centerton	3
Hempstead County:	
May 9—	
Hope	1
Ark., State total	4

CALIFORNIA.

Butte County:	
Feb. 3—	
Chico	1
Contra Costa County:	
Sept. 1–Nov. 20:	
Danville	7
Knightsen	3
Oakley	2
Fresno County:	
Sept. 1–Dec. 29—	
Del Rey	3
Fresno	182
Orange County:	
Feb. 8—	
Santa Ana	2
Sacramento County:	
Oct. 12—	
Bradshaw	1
San Bernardino County:	
Apr. 22—	
Ontario	1
Santa Clara County:	
Sept.—	
San Jose	3
Solano County:	
Jan. 20–Nov. 8—	
Suisun	2
Sonoma County:	
Sept. 16—	
Sebastopol	1
Sutter County:	
Oct. 12—	
Yuba City	1
Tulare County:	
Nov. 15—	
Visalia	1
Yolo County:	
Sept. 26—	
Guinda	1
Cal., State total	211

COLORADO.

	Cars.
Weld County:	
Nov. 1—	
Kersey	1
Colo., State total	1

GEORGIA.

Appling County:	
July 1–Oct. 14—	
Baxley	23
Ga., State total	23

IOWA.

Cerro Gordo County:	
Nov. 3—	
Mason City	1
Iowa, State total	1

LOUISIANA.

Orleans Parish:	
Dec. 6—	
New Orleans	6
La., State total	6

MISSOURI.

St. Louis City:	
Jan. 27–Dec. 16—	
St. Louis	29
Mo., State total	29

NEW YORK.

New York County:	
June 24–Nov. 25—	
New York	8
N. Y., State total	8

OREGON.

Marion County:	
Feb. 23—	
Salem	1

OREGON—Continued.

	Cars.
Multnomah County:	
July 25–Nov. 10—	
East Portland	1
Portland	2
Oreg., State total	4

TEXAS.

Dallas County:	
Feb. 25–Dec. 24—	
Dallas	1
Tarrant County:	
Sept, 15—	
Fort Worth	1
Tex., State total	2

VIRGINIA.

Campbell County:	
Dec. 18–19—	
Lynchburg	3
Frederick County:	
Sept. 23—	
Winchester	1
Patrick County:	
Dec.	
Stuart	1
Va., State total	5

WASHINGTON.

Lincoln County:	
July 31—	
Creston	1
Wash., State total	1

WEST VIRGINIA.

Wood County:	
Sept. 27–Oct. 5—	
Parkersburg	3
V. Va., State total	3

CITRUS FRUITS.

Table 20.—ORANGES.

ALABAMA.

	Cars.
Baldwin County:	
Dec. 2—	
Loxley	1
Mobile County:	
Nov. 26–Dec. 31—	
Grand Bay	16
Irvington	4
Ala., State total	21

ARIZONA.

Maricopa County:	
Nov. 11–Dec. 29—	
Mesa	1
Phoenix	94
Santa Cruz County:	
Oct. 27–Nov. 1—	
Nogales	4
Ariz., State total	99

CALIFORNIA.

Alameda County:	
Nov. 24–Apr. 18—	
Oakland	4
Butte County:	
May 13–Dec. 19—	
Oroville	135
Palermo	320
Thermalito	54
Colusa County:	
Nov. 11–Dec. 22—	
Magnolia	121
Fresno County:	
Jan. 1–Dec. 25—	
Fresno	6
Minkler	16
Reedley	47
Sanger	233
Glenn County:	
Dec. 8–22—	
Orland	10
Imperial County:	
Mar. 14—	
Brawley	1
Inyo County:	
Oct. 13—	
Kearsarge	1
Kern County:	
Nov. 7–Dec. 20—	
Bakersfield	27
Famoso	1
Kings County:	
Feb. 3–4—	
Armona	2
Los Angeles County:	
Jan. 1–Dec. 31—	
Alhambra	1
Arcadia	106
Azusa	699
Azusa Avenue	80
Baldwin Park	1
Chapman	5
Charter Oak	376
Claremont	186
Colegrove	2
Covina	1,407
Downey	128
Duarte	455
East Alhambra	73
East San Pedro	1
El Monte	1
Gardena	1
Glendale	85
Glendora	1,189
Hermosillo	28
Irwindale	246
Joko	3
Lamanda Park	6
La Mirada	19
Lankershim	15

CALIFORNIA—Continued.

	Cars.
Los Angeles County—Con.	
Jan. 1–Dec. 31—	
Las Lomas	34
Lateen	82
Long Beach	1
Lordsburg	929
Los Angeles	94
Los Nietos	8
Monrovia	291
Newmark	1
North Pomona	527
Pacoima	35
Pasadena	434
Pico	65
Pomona	963
Puente	1
Redondo Beach	1
Rivera	436
Rossmoyne	37
San Dimas	592
San Fernando	306
San Fernando Mission	33
San Gabriel	58
San Marino	163
Saugus	7
Shorb	608
Villa Vista	26
Walnut	135
Whittier	850
Marin County:	
Jan. 12–Dec. 31—	
Highland	358
Orange County:	
Jan. 1–Dec. 31—	
Anaheim	744
Buena Park	1
Des Moines	64
El Modena	10
Fullerton	789
Garden Grove	10
La Habra	250
McPherson	62
Olive	262
Orange	1,189
Placentia	1,345
Richfield	2
Santa Ana	97
Tustin	411
Villa Park	348
West Anaheim	81
West Orange	5
Yorba	1
Yorba Linda	2
Placer County:	
Jan. 1–Dec. 31—	
Loomis	43
Penryn	5
Rocklin	6
Roseville	6
Riverside County:	
Jan. 1–Dec. 31—	
Arlington	461
Casa Blanca	41
Concrete	26
Corona	794
Crestmore Junction	1
Hemet	89
Highgrove	484
May	5
Mecca	4
Ormand	20
Pachappa	39
Pedley	24
Porphyry	40
Prenda	31
Riverside	1,071
Wineville	9
Sacramento County:	
Jan. 6–Dec. 31—	
Brighton	7
Fair Oaks	157
Folsom	108
Sacramento	5

CALIFORNIA—Continued.

	Cars.
San Bernardino County:	
Jan. 1–Dec. 31—	
Alta Loma	190
Bloomington	159
Colton	274
Crafton	342
Crestmore	31
Cucamonga	908
Del Rosa	143
East Highlands	981
Etiwanda	91
Fontana	12
Highland	19
Mentone	114
Narod	43
Ontario	525
Patton	42
Redlands	2,723
Redlands Junction	399
Rialto	902
San Bernardino	199
Upland	1,708
San Diego County:	
Jan. 10–Dec. 12—	
El Cajon	52
Escondida	55
Miramar	2
National City	14
San Diego	11
San Francisco County:	
Mar. 10–Dec. 26—	
San Francisco	4
Santa Barbara County:	
Feb. 4–Sept. 15—	
Carpenteria	4
Santa Barbara	32
Tehama County:	
Jan. 5–Dec. 23—	
Corning	21
Tulare County:	
Jan. 1–Dec. 31—	
Cutler	19
Exeter	437
Lemon Cove	329
Lindsay	2,208
Merryman	6
North Dinuba	19
Porterville	1,120
Strathmore	276
Sultana	34
Terra Bella	121
Woodlake	79
Ventura County:	
Jan. 14–Dec. 18—	
Fillmore	448
Nordhoff	175
Ortonville	1
Piru	131
Santa Paula	70
Saticoy	3
Ventura	3
Yolo County:	
Jan. 1–Dec. 6—	
Davis	4
Yuba County:	
Jan. 19—	
Mission	1
Cal., State total	37,796

FLORIDA.

Alachua County:	
Nov. 16–Feb. 13—	
Evinston	2
Island Grove	17
Lochloosa	6
Micanopy	36
Orange Heights	9
Wacahoota	1
Waldo	12

CITRUS FRUITS—Continued.

Table 20.—ORANGES—Continued.

FLORIDA—Continued.

	Cars.
Brevard County:	
Nov.–Mar.—	
Cocoa	775
Eau Gallie	46
Hopkins	40
Mims	171
Titusville	295
Broward County:	
Nov.–Feb—	
Dania	32
Fort Lauderdale	6
Hallandale	8
Citrus County:	
Oct. 18–Dec. 19—	
Floral City	15
Inverness	27
Dade County:	
Nov.–Mar.—	
Arch Creek	6
Cocoanut Grove	358
Fulford	11
Goulds	70
Homestead	56
Larkins	137
Lemon City	14
Miami	252
Perrine	3
Princeton	75
De Soto County:	
Nov.–May—	
Arcadia	244
Avon Park	110
Bowling Green	205
Fort Green	40
Fort Green Springs	63
Fort Ogden	60
Nocatee	30
Ona	141
Wauchula	162
Zolfo	92
Duval County:	
Oct.–May—	
Florida Transfer	70
Jacksonville	24
Hillsborough County:	
Oct.–Apr.—	
Brandon	41
Dover	24
Knights	66
Plant City	116
Port Tampa City	4
Seffner	67
Tampa	136
Thonotasassa	190
Valrico	2
Ybor City	5
Lake County:	
Oct.–Mar.—	
Astatula	19
Clermont	26
Eustis	68
Groveland	3
Leesburg	160
Lisbon	10
Mascotte	26
Montverde	11
Mount Dora	137
Tavares	78
Lee County:	
Oct. 17–Dec. 24—	
Fort Meyers	48
Manatee County:	
Nov.–May—	
Bradentown	28
Ellenton	33
Manatee	1
Oneco	23
Palmetto	1
Sarasota	1
Venice	3

FLORIDA—Continued.

	Cars.
Marion County:	
Oct.–May—	
Boardman	35
Candler	17
Citra	55
Grays Landing	54
Irvine	27
Ocala	40
South Lake Weir	106
Sparr	40
Summerfield	60
Weirsdale	11
Monroe County:	
Nov.—	
Jewfish	1
Orange County:	
Oct.–Apr.—	
Apopka	20
Clarcona	12
Lockhart	3
Maitland	375
Ocoee	98
Orlando	1,557
Plymouth	104
Tildenville	133
Winter Garden	60
Winter Park	1
Osceola County:	
Nov.–Feb.—	
Kenansville	34
Kissimmee	205
Palm Beach County:	
Nov.–Feb.—	
Boynton	1
Delray	5
Jupiter	19
Lake Worth	14
Stuart	57
Pasco County:	
Nov.–Feb.—	
Dade City	20
Pinellas County:	
Oct.–Feb.—	
Coachman	58
Clearwater	105
Largo	85
Safety Harbor	16
St. Petersburg	18
Sutherland	1
Tarpon Springs	55
Polk County:	
Oct.–June—	
Auburndale	38
Bartow	120
Bradley Junction	47
Brewster	10
Chicora	19
Florence Villa	14
Homeland	74
Lakeland	225
Mulberry	3
Putnam County:	
Oct.–Dec.—	
Pomona	68
San Mateo	34
St. Johns County:	
Oct.–Jan.—	
Hastings	31
St. Augustine	9
St. Lucie County:	
Oct.–Feb.—	
Fort Pierce	104
Jensen	23
Okeechobee	91
Sebastian	93
Vero	174
Walton	2
White City	79

FLORIDA—Continued.

	Cars.
Seminole County:	
Nov.–Apr.—	
Chuluota	11
Geneva	85
Longwood	37
Oviedo	47
Sanford	45
Sumter County:	
Oct. 16–June 1—	
Wildwood	147
Volusia County:	
Nov.–Apr.—	
Bonds Mill	1
Daytona	28
De Land	599
De Leon Springs	165
Farmton	3
Glenwood	59
Lake Helen	105
Maytown	7
New Smyrna	141
Oak Hill	458
Orange City	15
Ormond	22
Pierson	16
Port Orange	11
Fla., State total	11,810

GEORGIA.

Chatham County:	
Nov.–Dec.—	
Savannah	22
Ga., State total	22

LOUISIANA.

Orleans Parish:	
Oct. 26–Dec. 21—	
New Orleans	61
La., State total	61

MARYLAND.

Baltimore City:	
Jan. 3–Dec. 28—	
Baltimore	68
Md., State total	68

MASSACHUSETTS.

Suffolk County:	
July 6–Dec. 26—	
Boston	50
Mass., State total	50

NEW JERSEY.

Hudson County:	
Jan. 22–Dec. 31—	
Manhattan Piers	95
N. J., State total	95

NEW YORK.

New York County:	
Feb. 6–Dec. 20—	
New York City	26
Richmond County:	
Sept. 28–Dec. 7—	
St. George Lighterage	9
N. Y., State total	35

CITRUS FRUITS—Continued.

Table 20.—ORANGES—Continued.

OREGON.

	Cars.
Multnomah County:	
May 26–Dec. 30—	
East Portland	6
Portland	4
Oreg., State total	10

PENNSYLVANIA.

Philadelphia County:	
Philadelphia	40
Pa., State total	40

RHODE ISLAND.

	Cars.
Providence County:	
Feb. 17—	
Providence	1
R. I., State total	1

TEXAS.

Brazoria County:	
Nov. 9–Dec. 12—	
Alvin	14
Dallas County:	
Aug. 16—	
Dallas	1

TEXAS—Continued.

	Cars.
Galveston County:	
Nov. 28–Dec. 11—	
League City	3
Harris County:	
Nov. 11—	
La Porte	1
Tex., State total	19

WASHINGTON.

King County:	
Dec. 4–Dec. 12—	
Seattle	7
Wash., State total	7

Table 21.—LEMONS.

CALIFORNIA.

	Cars.
Fresno County:	
Jan. 23–Dec. 7—	
Sanger	5
Los Angeles County:	
Jan. 1–Dec. 31—	
Azusa	127
Azusa Avenue	1
Burbank	1
Charter Oak	5
Claremont	2
Colegrove	39
Covina	5
Downey	1
Duarte	7
East San Pedro	6
El Monte	13
Glendale	60
Glendora	206
Irwindale	2
Joko	2
Lamanda Park	7
La Mirada	65
Lankershim	72
Las Lomas	1
Leffingwell	22
Lordsburg	100
Los Angeles	108
Monrovia	40
North Pomona	1
Pacoima	6
Pasadena	1
Pomona	66
Redondo Beach	1
Rossmoyne	5
San Dimas	411
San Fernando	50
San Fernando Mission	64
San Gabriel	5
San Pedro	15
Saugus	2
Sherman	6
Spalding Spur	1
Van Nuys	3
Vernondale	1
Villa Vista	2
Walnut	3
Whittier	422
Marin County:	
Jan. 4–Dec. 2—	
Highland	17
Orange County:	
Jan. 1–Dec. 31—	
Anaheim	11
Des Moines	42
El Modena	20
Fullerton	3
Garden Grove	1
La Habra	208
McPherson	3
Olive	29

CALIFORNIA—Continued.

	Cars.
Orange County—Contd.	
Jan. 1–Dec. 31—	
Orange	4
Placentia	8
Santa Ana	4
Tustin	229
Villa Park	138
West Anaheim	11
Yorba	19
Yorba Linda	60
Riverside County:	
Jan. 1–Dec. 31—	
Arlington	142
Casa Blanca	3
Concrete	1
Corona	677
Crestmore Junction	1
Highgrove	4
Ormand	2
Pedley	5
Porphyry	120
Prenda	6
Riverside	20
Wineville	1
Sacramento County:	
Feb. 7–12—	
Folsom	3
San Bernardino County:	
Jan. 1–Dec. 31—	
Alta Loma	51
Bloomington	53
Colton	6
Crafton	1
Crestmore	9
Cucamonga	26
Del Rosa	24
East Highlands	37
Etiwanda	46
Fontana	3
Highlands	6
Mentone	1
Narod	1
Ontario	7
Redlands	16
Redlands Junction	9
Rialto	109
San Bernardino	1
Upland	474
San Diego County:	
Jan. 4–Dec. 23—	
Chula Vista	155
El Cajon	23
Escondida	195
La Mesa	8
Lemon Grove	2
Miramar	60
National City	167
San Diego	31
Santee	2
Vista	14

CALIFORNIA—Continued.

	Cars.
San Francisco County:	
Nov. 14—	
San Francisco	1
Santa Barbara County:	
Jan. 3–Dec. 31—	
Carpenteria	48
Santa Barbara	216
Summerland	1
Tehama County:	
Mar. 2—	
Corning	1
Tulare County:	
Jan. 1–Dec. 31—	
Cutler	2
Exeter	9
Lemon Cove	124
Lindsay	34
Porterville	40
Woodlake	8
Ventura County:	
Jan. 1–Dec. 31—	
Carmicle	7
Fillmore	198
Kevet	6
Montalvo	1
Nordhoff	2
Ortonville	19
Piru	3
Santa Paula	384
Saticoy	271
Sespe	5
Ventura	158
Cal., State total	6,829

LOUISIANA.

Orleans Parish:	
June 10–Aug. 18—	
New Orleans	28
La., State total	28

MARYLAND.

Baltimore City:	
Feb. 14–Dec. 18—	
Baltimore	42
Md., State total	42

MASSACHUSETTS.

Suffolk County:	
Nov. 27–Dec. 26—	
Boston	7
Mass., State total	7

CITRUS FRUITS—Continued.

Table 21.—LEMONS—Continued.

NEW JERSEY.

	Cars.
Hudson County:	
Jan. 10–Dec. 31—	
Manhattan Piers	324
N. J., State total	324

NEW YORK.

Bronx County:	
Aug. 1—	
St. Johns Park	1
Kings County:	
Sept. 22–30—	
Brooklyn	14
New York County:	
Jan. 27–Dec. 28—	
New York City	73

NEW YORK—Continued.

	Cars.
Richmond County:	
Feb. 12–Dec. 28—	
St. George Lighterage	154
N. Y., State total	242

PENNSYLVANIA.

Philadelphia County:	
Sept.—	
Philadelphia	4
Pa., State total	4

TEXAS.

	Cars.
Galveston County:	
Feb. 20–Aug. 9—	
Galveston	5
Tex., State total	5

WASHINGTON.

King County:	
July 7—	
Seattle	1
Wash., State total	1

Table 22.—GRAPEFRUIT.

ARIZONA.

	Cars.
Maricopa County:	
Nov. 11–Dec. 2—	
Phoenix	2
Ariz., State total	2

CALIFORNIA.

Butte County:	
Dec.–July—	
Palermo	3
Imperial County:	
Feb. 9—	
Imperial	1
Los Angeles County:	
Feb. 21–Nov. 4	
Azusa	1
Charter Oak	3
Claremont	1
Covina	1
Duarte	1
Glendale	2
La Mirada	2
Los Angeles	4
Pomona	2
Rivera	1
San Dimas	11
San Fernando	3
San Pedro	1
Walnut	1
Whittier	2
Marin County:	
July 3–Aug. 26—	
Highland	6
Orange County:	
May 24–July 6—	
Fullerton	2
La Habra	1
Placentia	1
West Anaheim	1
Riverside County:	
Apr. 18–Sept. 27	
Arlington	2
Corona	15
Highgrove	11
Pachappa	2
Riverside	6
Wildomar	2
Sacramento County:	
Nov. 11–17—	
Folsom	5
San Bernardino County:	
Jan. 1–Dec. 31—	
Alta Loma	2
Bloomington	5
Cucamonga	1
East Highlands	69
Fontana	1
Highland	1

CALIFORNIA—Continued.

	Cars.
San Bernardino County—Continued.	
Jan. 1–Dec. 31—	
Mentone	2
Ontario	6
Redlands	14
Redlands Junction	9
Rialto	15
San Bernardino	5
Upland	2
San Diego County:	
June 3–July 1.	
Escondido	5
Santa Barbara County:	
Sept. 4—	
Carpenteria	2
Tulare County:	
Jan. 5–Dec. 29—	
Cutler	1
Exeter	14
Lemon Cove	45
Lindsay	26
Merryman	3
Naranjo	5
Porterville	18
Strathmore	2
Woodlake	4
Ventura County:	
Mar. 7–20—	
Nordhoff	3
Piru	1
Cal., State total	355

FLORIDA.

Alachua County:	
Nov.—	
Micanopy	5
Waldo	5
De Soto County:	
Nov.–May—	
Arcadia	75
Fort Ogden	40
Nocatee	10
Ona	13
Wauchula	10
Zolfo	12
Duval County:	
Nov.–May—	
Florida Transfer	6
Jacksonville	39
Hillsborough County:	
Nov.–Apr.—	
Brandon	2
Port Tampa City	1
Tampa	200
Thonotasassa	5
Valrico	2

FLORIDA—Continued.

	Cars.
Lake County:	
Oct.–Jan.—	
Clermont	11
Eustis	23
Leesburg	70
Mount Dora	28
Tavares	69
Lee County:	
Dec. 22–May 24—	
Fort Meyers	51
Manatee County:	
Nov.–May—	
Bradentown	42
Ellenton	44
Manatee	3
Sarasota	8
Venice	11
Marion County:	
Oct.–May—	
Irvine	2
Ocala	5
South Lake Weir	1
Summerfield	15
Weirsdale	5
Orange County:	
Sept.–May—	
Clarcona	6
Lockhart	1
Ocoee	4
Orlando	452
Winter Park	3
Osceola County:	
Nov.–Feb.—	
Kissimmee	30
Pinellas County:	
Oct.–May—	
Clearwater	130
Coachman	77
Dunedin	5
Largo	114
Safety Harbor	69
St. Petersburg	50
Sutherland	7
Tarpon Springs	13
Polk County:	
Oct.–May—	
Auburndale	27
Bartow	2
Eagle Lake	6
Florence Villa	25
Lakeland	26
Winter Haven	1
Putnam County:	
Oct. 28–Nov. 27—	
Pomona	2
Sumter County:	
May 16–June 2—	
Wildwood	6

CITRUS FRUITS—Continued.

Table 22.—GRAPEFRUIT—Continued.

FLORIDA—Continued.

	Cars.
Volusia County:	
Nov.-May—	
De Land	1
De Leon Springs	2
Pierson	2
Fla., State total	1,874

MARYLAND.

Baltimore City:	
Jan. 12-Dec. 20—	
Baltimore	15
Md., State total	15

MASSACHUSETTS.

	Cars.
Suffolk County:	
Nov. 17-Dec. 27—	
Boston	4
Mass., State total	4

NEW JERSEY.

Hudson County:	
Jan. 6-Dec. 31—	
Manhattan Piers	63
N. J., State total	63

NEW YORK.

	Cars.
New York County:	
Feb. 7-Dec. 20—	
New York City	5
Richmond County:	
Nov. 2-Dec. 7—	
St. George Lighterage	8
N. Y., State total	13

TEXAS.

Dallas County:	
Nov.—	
Dallas	1
Tex., State total	1

Table 23.—LIMES.

CALIFORNIA.

	Cars.
Eldorado County:	
Oct. 7—	
Cothrin	1
Cal., State total	1

NEW YORK.

	Cars.
Orange County:	
Aug. 20-Oct. 15—	
Pine Island	3
N. Y., State total	3

TEXAS.

	Cars.
Galveston County:	
Apr. 27-Sept. 9—	
Galveston	6
Tex., State total	6

Table 24.—TANGERINES.

CALIFORNIA.

	Cars.
Los Angeles County:	
Mar. 4—	
San Dimas	1
Riverside County:	
Mar. 18—	
Highgrove	1
San Bernardino County:	
Mar. 14—	
Redlands Junction	1
Tulare County:	
Dec. 15—	
Lemon Cove	2
Ventura County:	
Mar. 14—	
Nordhoff	1
Cal., State total	6

FLORIDA.

	Cars.
Alachua County:	
Nov. 17-Dec. 20—	
Waldo	4
De Soto County:	
Dec.—	
Wauchula	1
Zolfo	1
Lee County:	
Dec. 19—	
Fort Meyers	1
Manatee County:	
Dec.—	
Ellenton	2
Venice	1

FLORIDA—Continued.

	Cars.
Pinellas County:	
Dec. 12-22—	
Largo	2
Fla., State total	12

MASSACHUSETTS.

Suffolk County:	
Dec. 4—	
Boston	1
Mass., State total	1

SUB-TROPICAL FRUIT.

Table 25.—BANANAS.

ALABAMA.

	Cars.
Mobile County:	
Jan.-Dec.—	
Mobile	142
Ala., State total	142

CALIFORNIA.

Sacramento County:	
Apr. 10-25—	
Sacramento	2
San Francisco:	
Jan. 10-Dec. 5—	
San Francisco	11
Cal., State total	13

LOUISIANA.

Orleans Parish:	
Jan. 1-Dec. 16—	
New Orleans	5,367
La., State total	5,367

MARYLAND.

	Cars.
Baltimore City:	
Jan. 3-Dec. 26—	
Baltimore	445
Md., State total	445

MASSACHUSETTS.

Suffolk County:	
Jan. 1-Dec. 26—	
Boston	2,213
Mass., State total	2,213

NEW JERSEY.

Hudson County:	
Jan. 12-Dec. 27—	
Weehawken	44
N. J., State total	44

NEW YORK.

	Cars.
New York County:	
Jan. 24-Dec. 22—	
New York City	4,699
N. Y., State total	4,699

NORTH CAROLINA.

New Hanover County:	
June 6-Nov. 11—	
Wilmington	11
N. C., State total	11

PENNSYLVANIA.

Philadelphia County:	
Jan. 5-Dec. 26—	
Philadelphia	780
Pa., State total	780

SUB-TROPICAL FRUITS—Continued.

Table 25.—BANANAS—Continued.

RHODE ISLAND.

	Cars.
Providence County:	
May 7—	
South Providence	1
R. I., State total	1

TEXAS.

	Cars.
Galveston County:	
Jan. 3–Dec. 31—	
Galveston	2,584
Tex., State total	2,584

WASHINGTON.

	Cars.
Snohomish County:	
Oct. 1–Nov. 23—	
Everett	2
Wash., State total	2

Table 26.—FRESH FIGS.

CALIFORNIA.

	Cars.
Riverside County:	
June 4–June 26—	
Coachella	2
Cal., State total	2

Table 27.—PINEAPPLES.

CALIFORNIA.

	Cars.
San Francisco County:	
May 31—	
San Francisco	1
Cal., State total	1

FLORIDA.

Broward County:	
June–Dec.—	
Dania	1
Hallandale	13
Dade County:	
June–Dec.—	
Little River	49
Duval County:	
June–Dec.—	
Jacksonville	34
Palm Beach County:	
June–Dec.—	
Boynton	78
Delray	64
Jupiter	2
Stuart	84

FLORIDA—Continued.

	Cars.
St. Lucie County:	
June–Dec.—	
Fort Pierce	89
Jensen	74
Vero	194
Walton	7
White City	85
Fla., State total	774

LOUISIANA.

Orleans Parish:	
May 21–June 21—	
New Orleans	3
La., State total	3

MARYLAND.

Baltimore City:	
June 10–Aug. 17—	
Baltimore	3
Md., State total	3

NEW JERSEY.

	Cars.
Hudson County:	
Jan. 3–Dec. 31—	
Manhattan Piers	452
N. J., State total	452

NEW YORK.

New York County:	
June 5–Oct. 31—	
New York City	18
Richmond County:	
Sept. 28–Dec. 7—	
St. George Lighterage	47
N. Y., State total	65

PENNSYLVANIA.

Philadelphia County:	
Oct.–Dec.—	
Philadelphia	5
Pa., State total	5

Table 28.—POMEGRANATES.

CALIFORNIA.

	Cars.
Tulare County:	
Oct. 12–31—	
Lindsay	7
Cal., State total	7

BERRIES.

Table 29.—BLACKBERRIES.

CALIFORNIA.

	Cars.
Sonoma County:	
June 1–28—	
Sebastopol	55
Cal., State total	55

DELAWARE.

Sussex County:	
June 28–July 20—	
Laurel	11
Lincoln City	33
Milford	3
Seaford	1
Del., State total	48

INDIANA.

	Cars.
Clark County:	
June 27–Aug. 1—	
Borden	22
Sellersburg	33
Floyd County:	
June 26–July 22—	
New Albany	11
Ind., State total	66

KANSAS.

Doniphan County:	
July—	
Wathena	1
Kan., State total	1

MARYLAND.

	Cars.
Dorchester County:	
June 28–July 1—	
East New Market	17
Talbot County:	
July—	
Claiborne	1
June–July:	
Choptank River landings	5
June–July:	
Nanticoke River landings	2
June:	
Wicomico River landings	4
Md., State total	29

BERRIES—Continued.

Table 29.—BLACKBERRIES—Continued.

MICHIGAN.

	Cars.
Mason County:	
July 16–Sept. 7—	
Ludington	4
Mich., State total	4

MISSOURI.

Buchanan County:	
July 17–24—	
St. Joseph	5
Mo., State total	5

NEW JERSEY.

Atlantic County:	
July 1–Aug. 21—	
Hammonton	52
Landisville	73
Wheat Road	39
Camden County:	
July 25–Aug. 7—	
Elm	18

NEW JERSEY—Continued.

	Cars.
Cumberland County:	
July 12—	
Vineland	1
Monmouth County:	
July 19–Aug. 5—	
Freehold	1
Port Monmouth	1
N. J., State total	185

TENNESSEE.

Weakley County:	
June—	
Greenfield	24
Tenn., State total	24

TEXAS.

Wood County:	
May 18–June 14—	
Winnsboro	4
Tex., State total	4

VIRGINIA.

	Cars.
June—	
Rappahannock River landings	1
Va., State total	1

WASHINGTON.

Pierce County:	
Aug. 28–Sept. 11—	
Puyallup	39
Wash., State total	39

WISCONSIN.

Washburn County:	
July 5–Aug. 30—	
Minong	3
Wis., State total	3

Table 30.—CRANBERRIES.

ILLINOIS.

	Cars.
Cook County:	
Nov.–Jan.—	
Chicago	4
Peoria County:	
Dec. 22—	
Peoria	1
Ill., State total	5

MASSACHUSETTS.

Barnstable County:	
Sept. 21–Feb.—	
Barnstable	3
Bass River	5
Bourne	2
Buzzards Bay	25
East Brewster	1
East Sandwich	22
Falmouth	40
Harwich	7
Hyannis	7
North Falmouth	5
North Harwich	19
Sagamore	4
Sandwich	7
South Chatham	6
South Dennis	26
West Barnstable	50
Yarmouth	7
Bristol County:	
Sept. 14–Dec. 26—	
Braleys	11
East Taunton	1
Norton	14
Middlesex County:	
Oct. 28—	
South Chelmsford	1
Plymouth County:	
Aug.–Mar. 16—	
Burrage	25
Darby	30
Duxbury	3
Greenbush	7
Hanover	13
Kingston	4
Lakeville	3
Marion	13
Marshfield Hills	7
Mattapoisett	2
Middleboro	7
Nemasket	3
North Carver	159
Plymouth	112
Plympton	3
Rock	21
Seaside	3
South Hanson	57

MASSACHUSETTS—Contd.

	Cars.
Plymouth County—Contd.	
Aug.–Mar. 16—	
South Middleboro	52
South Wareham	89
Tremont	186
Wareham	89
Mass., State total	1,151

MICHIGAN.

Grand Traverse County:	
Nov. 1–30—	
Walton Junction	2
Mich., State total	2

MISSOURI.

Jackson County:	
Apr.—	
Kansas City	1
Mo., State total	1

NEBRASKA.

Lancaster County:	
Mar. 14—	
Lincoln	1
Nebr., State total	1

NEW JERSEY.

Atlantic County:	
Sept. 13–Dec. 31—	
Egg Harbor	14
Elwood	4
Mays Landing	23
Burlington County:	
Sept. 1–Dec. 31—	
Atsion	95
Brown's Mill-in-the-Pines	1
Cookstown	10
Hanover Farms	96
Lumberton	1
Marlton	6
Medford	41
Pemberton	1
South Pemberton	68
Camden County:	
Nov. 17–Dec. 11—	
Waterford	12
Cape May County:	
Nov. 16–Dec. 6—	
Tuckahoe	2
Cumberland County:	
Oct. 5–Dec.—	
Leesburg	1
Port Norris	1
Vineland	1

NEW JERSEY—Continued.

	Cars.
Gloucester County:	
Nov.—	
Malaga	1
Middlesex County:	
Nov.—	
Jamesburg	2
Monmouth County:	
Nov. 10–Dec. 27—	
Farmingdale	10
Hornerstown	2
Ocean County:	
Oct. 20–Mar. 15—	
Barnegat	29
Mantoloking	2
New Egypt	15
South Lakewood	17
Toms River	23
Tuckerton	5
West Creek	1
N. J., State total	484

NEW YORK.

Suffolk County:	
Nov.—	
Jamesport	1
N. Y., State total	1

WISCONSIN.

Jackson County:	
Oct. 27–Nov. 15—	
City Point	5
Juneau County:	
Oct. 15–Nov. 20—	
Mather	38
Monroe County:	
Sept.–Nov. 28—	
North Tomah	4
Shennington	4
Tomah	1
Valley Junction	4
Warren	13
Shawano County:	
Oct.—	
Tigerton	4
Waupaca County:	
Dec. 5—	
Waupaca	1
Wood County:	
Oct. 10–Nov. 25—	
Babcock	2
Grand Rapids	69
Wis., State total	145

BERRIES—Continued.

Table 31.—DEWBERRIES.

NEW YORK.

	Cars.
Columbia County:	
July 18–Aug. 11—	
Germantown	9
N. Y., State total	9

NORTH CAROLINA.

	Cars.
Harnett County:	
June—	
Spout Springs	1
Lee County:	
June 3–24—	
Broadway	5
Jonesboro	25
Lee County—Continued.	
June 3–24—	
Lemon Springs	10
Sanford	1
Moore County:	
June 3–27—	
Aberdeen	6
Cameron	57
Carthage	57
Vass	17
Richmond County:	
June 3–16—	
Hamlet	4
Hoffman	13
Sampson County:	
June 8—	
Clinton	2
N. C., State total	198

TEXAS.

	Cars.
Wood County:	
May 26–30—	
Winnsboro	3
Tex., State total	3

Table 32.—GOOSEBERRIES.

MARYLAND.

	Cars.
June:	
Choptank River landings	1
Md., State total	1

NEW JERSEY.

	Cars.
Mercer County:	
June 13–15—	
Trenton	3
N. J., State total	3

NEW YORK.

	Cars.
Chautauqua County:	
July 7–Nov. 2—	
Portland	88
Ripley	1
N. Y., State total	89

PENNSYLVANIA.

	Cars.
Erie County:	
July 11–12—	
North East	2
Pa., State total	2

WISCONSIN.

	Cars.
Door County:	
July 16–30—	
Sturgeon Bay	6
Wis., State total	6

Table 33.—HUCKLEBERRIES.

CALIFORNIA.

	Cars.
Los Angeles County:	
July 22–Aug. 25—	
Covina	2
Cal., State total	2

MARYLAND.

Queen Annes County:	
July—	
Love Point	1
Talbot County:	
June–Aug. 13—	
Claiborne	2
Aug. 15:	
Nanticoke River landings	1
Md., State total	4

MICHIGAN.

Chippewa County:	
Aug. 14–25—	
Sault Ste. Marie	29
Mackinac County:	
Sept. 28—	
Mackinac Island	1
Manistee County:	
Aug. 20—	
Manistee	1
Mason County:	
Aug. 20–Sept. 5—	
Ludington	3
Mich., State total	34

NEW JERSEY.

Monmouth County:	
July 5–17—	
Freehold	5
N. J., State total	5

NORTH CAROLINA.

Wayne County:	
June 8–17—	
Mount Olive	2
N. C., State total	2

PENNSYLVANIA.

Carbon County:	
July 1–Sept. 1—	
Audenried	15
Luzerne County:	
July 8–Aug. 29—	
Hazleton	33
Monroe County:	
July—	
Reeders	2
Schuylkill County:	
June 25–Sept. 1—	
Oneida	20
Pa., State total	70

VIRGINIA.

Rockbridge County:	
Aug.—	
Riverside	1
Rockingham County:	
July 1–Sept. 7—	
Elkton	4
Va., State total	5

Table 34.—LOGANBERRIES.

CALIFORNIA.

	Cars.
Sonoma County:	
May 26–July 4—	
Sebastopol	62
Cal., State total	62

BERRIES—Continued.

Table 35.—RASPBERRIES.

	Cars.
CALIFORNIA.	
Sonoma County:	
May 26–June 10—	
Sebastopol	1
Cal., State total	1
COLORADO.	
Denver County:	
Aug. 10—	
Denver	1
Colo., State total	1
INDIANA.	
Clark County:	
June 15–July 7—	
Borden	9
Sellersburg	4
Floyd County:	
June 13–July 21—	
New Albany	17
Ind., State total	30
MARYLAND.	
Washington County:	
June–July—	
Rohrersville	10
Smithsburg	14
June–Aug.:	
Nanticoke River landings	2
June:	
Wicomico River landings	1
Md., State total	27
MICHIGAN.	
Benzie County:	
July 22–Aug. 31—	
Frankfort	3
MICHIGAN—Continued.	
Berrien County:	
July 9–17—	
Benton Harbor	55
Manistee County:	
July 1–Aug. 10—	
Manistee	2
Onekama	6
Muskegon County:	
July 17–Aug. 2—	
Muskegon	8
Ottawa County:	
July 10–Aug. 31—	
Grand Haven	8
Van Buren County:	
July 14–26—	
South Haven	10
Mich., State total	92
MISSOURI.	
Buchanan County:	
July 3—	
St. Joseph	1
Mo., State total	1
NEW JERSEY.	
Atlantic County:	
June 25–July 20—	
Cologne	1
Hammonton	185
Camden County:	
July 18–Sept. 7—	
Elm	38
Monmouth County:	
July 11–14—	
Cliffwood	11
Freehold	4
N. J., State total	239
NEW YORK.	
Columbia County:	
July 19–20—	
Germantown	3
Orange County:	
July 4–28—	
Cedar Cliff	5
Roseton	6
Oswego County:	
July 27—	
New Haven	1
Ulster County:	
July 4–30—	
Esopus	1
Highland	34
Marlboro	29
Milton	5
Ulster Park	4
N. Y., State total	88
VIRGINIA.	
Montgomery County:	
June 1–30—	
Christiansburg	8
Va., State total	8
WASHINGTON.	
King County:	
July 25–Aug. 15—	
Auburn	3
Pierce County:	
July 5–31—	
Puyallup	77
Snohomish County:	
May–Aug.—	
Snohomish	3
Wash., State total	83

Table 36.—STRAWBERRIES.

	Cars.
ALABAMA.	
Butler County:	
Apr. 26–May 10—	
Bolling	2
Chilton County:	
Apr. 22–May 10—	
Thorsby	12
Conecuh County:	
Apr. 5–May 10—	
Castleberry	135
Cullman County:	
May 3–26—	
Cullman	50
Hanceville	18
Escambia County:	
Apr. 12–26—	
Atmore	25
Mobile County:	
Apr. 20–May 26—	
Theodore	17
Sumter County:	
Apr. 18–June 5—	
Cuba	34
Livingston	30
McConnell	25
York	50
Ala., State total	398
ARKANSAS.	
Benton County:	
May 12–June 2—	
Avoca	10
Cave Springs	36
ARKANSAS—Continued.	
Benton County—Contd.	
May 12–June 2—	
Decatur	49
Garfield	14
Gentry	4
Highfill	25
Siloam Springs	6
Conway County:	
Apr. 28–May 13—	
Morrillton	26
Craighead County:	
May 6–23—	
Jonesboro	12
Crawford County:	
Apr. 30–May 25—	
Alma	134
Dyer	33
Mountainburg	13
Mulberry	1
Rudy	10
Van Buren	99
Howard County:	
Apr. 27–May 28—	
Nashville	23
Independence County:	
May 4–25—	
Batesville	43
Jefferson County:	
May 10–25—	
Johnsons	53
Lonoke County:	
Apr. 29–May 12—	
Ward	21
ARKANSAS—Continued.	
Miller County:	
May—	
Garner	2
Scott County:	
May 9–13—	
Abbott	9
Searcy County:	
May 18–23—	
Leslie	5
Marshall	3
Sebastian County:	
May 9–13—	
Lavaca	3
Sevier County:	
Apr. 20—	
Horatio	31
Paraloma	1
Washington County:	
May 9–June 1—	
Farmington	65
Fayetteville	88
Lincoln	9
Litteral	12
Springdale	96
Tontitown	13
White County:	
Apr. 27–May 31—	
Bald Knob	157
Bradford	59
Crosby	5
Higginson	39
Judsonia	330
McRae	63
Pangburn	4
Searcy	38

BERRIES—Continued.

Table 36.—STRAWBERRIES—Continued.

ARKANSAS—Continued.

	Cars.
Yell County:	
May 3-12—	
Dardanelle	6
Ark., State total	1,650

CALIFORNIA.

Fresno County:	
Apr. 17-May 8—	
Fresno	19
Los Angeles County:	
Apr. 8-May 1—	
Gardena	256
Placer County:	
Apr. 20-May 15—	
Newcastle	4
Sacramento County:	
Apr. 20-May 18—	
Brighton	1
Elk Grove	11
Florin	151
Sacramento	23
Santa Clara County:	
Apr.-May—	
Alviso	100
Santa Cruz County:	
May—	
Watsonville	38
Sonoma County:	
May 28-June 13—	
Sebastopol	4
Cal., State total	607

COLORADO.

Denver County:	
June 20-July 7—	
Denver	15
Montrose County:	
June—	
Montrose	3
Colo., State total	18

CONNECTICUT.

New Haven County:	
June 22-July 10—	
Branford	21
New Haven	21
Conn., State total	42

DELAWARE.

Kent County:	
June 1-22—	
Cheswold	8
Fulton	6
Hartly	13
Wyoming	45
Sussex County:	
May 22-July 5—	
Bridgeville	447
Cannon	3
Dagsboro	56
Delmar	42
Frankford	58
Georgetown	150
Greenwood	1
Laurel	25
Lincoln City	38
Millsboro	209
Seaford	98
Selbyville	844
Del., State total	2,043

FLORIDA.

	Cars.
Bradford County:	
Mar. 24-Apr. 24—	
Hampton	9
Lawtey	61
Raiford	2
Starke	134
Hillsborough County:	
Jan.-Mar.—	
Dover	5
Plant City	247
Polk County:	
Feb. 5-Mar. 14—	
Kathleen	14
Lakeland	100
Suwanee County:	
Apr. 24—	
Welborn	1
Fla., State total	573

ILLINOIS.

Adams County:	
June 2-20—	
Quincy	30
Cook County:	
May 8-Aug. 5—	
Chicago	4
Fayette County:	
May 26-June 13—	
Farina	33
Ladede	13
Jackson County:	
May 9-June 1—	
Makanda	12
Johnson County:	
May 27-29—	
Karnak	3
Marion County:	
May 27-June 8—	
Centralia	13
Massac County:	
May 22-June 11—	
Joppa	28
Metropolis	12
Pulaski County:	
May 14-June 8—	
Pulaski	33
Ullin	3
Villa Ridge	166
St. Clair County:	
May 30—	
East St. Louis	1
Union County:	
May 17-June 18—	
Anna	84
Cobden	2
Dongola	27
Washington County:	
May 30-June 3—	
Richview	2
White County:	
May 30—	
Carmi	1
Winnebago County:	
June 16-29—	
Rockford	5
Ill., State total	472

INDIANA.

Clark County:	
May 26-June 14—	
Borden	29
Floyd County:	
June 4-25—	
New Albany	45
Marion County:	
May 8-17—	
Indianapolis	2

INDIANA—Continued.

	Cars.
Washington County:	
May 30-June 12—	
Pekin	9
Ind., State total	85

IOWA.

Des Moines County:	
June 14-22—	
Burlington	4
Lee County:	
June 3-21—	
Keokuk	35
Montrose	25
Linn County:	
June 14-29—	
Cedar Rapids	8
Scott County:	
May 15-June 20—	
Davenport	2
Wapello County:	
June 4-23—	
Ottumwa	20
Iowa, State total	94

KANSAS.

Doniphan County:	
May 29-June 29—	
Blair	40
Troy	37
Wathena	88
Jackson County:	
June 1-19—	
Holton	14
Leavenworth County:	
May 2-June 16—	
Leavenworth	11
Kans., State total	190

KENTUCKY.

Hickman County:	
May 16-26—	
South Columbus	5
Jefferson County:	
June 2-15—	
Anchorage	8
Louisville	23
McCracken County:	
May 25-June 1—	
Paducah	4
Warren County:	
May 20-June 15—	
Bowling Green	370
Ky., State total	410

LOUISIANA.

Tangipahoa Parish:	
Mar. 20-May 27—	
Amite	119
Hammond	235
Independence	739
Ponchatoula	1
Tickfaw	165
Woodhaven	95
La., State total	1,354

MARYLAND.

Baltimore City:	
May 23-July 8—	
Baltimore	268
Caroline County:	
May 27-June 21—	
Federalsburg	64
Goldsboro	3
Greensboro	19
Ridgely	69

BERRIES—Continued.

Table 36.—STRAWBERRIES—Continued.

	Cars.
MARYLAND—Continued.	
Dorchester County:	
May 23–June 27—	
Cambridge	3
East New Market	7
Madison	1
Queen Annes County:	
May–June—	
Love Point	5
Somerset County:	
May 18–July 15—	
Costen	18
Crisfield (see Va.)	
Eden	21
Hopewell	66
Kings Creek	6
Kingston	2
Loretto	3
Marion	420
Princess Anne	130
Westover	80
Talbot County:	
May–June—	
Claiborne	2
Wicomico County:	
May 21–June 23—	
Fruitland	179
Parsonsburg	1
Pittsville	400
Salisbury	31
Walstons	2
Willards	94
Worcester County:	
May 25–June 20—	
Berlin	122
Pocomoke	6
Queponco	12
Showell	68
Snow Hill	18
Whaleyville	59
June:	
Chester River landings	1
May–June:	
Choptank River landings	29
Nanticoke River landings	31
Pocomoke River landings	2
Potomac River landings	4
Wicomico River landings	52
Md., State total	2,298
MASSACHUSETTS.	
Barnstable County:	
June 25–July 16—	
Falmouth	154
Suffolk County:	
May 31–June 14—	
Boston	6
Mass., State total	160
MICHIGAN.	
Berrien County:	
June 12–July 11—	
Benton Harbor	188
Bridgman	22
Sawyer	17
Genesee County:	
June 21–26—	
Montrose	2
Kent County:	
June–July—	
Gooding	1
Mason County:	
June 29–July 17—	
Ludington	11
MICHIGAN—Continued.	
Muskegon County:	
June 18–July 16—	
Muskegon	17
Ottawa County:	
June 19–July 27—	
Grand Haven	80
Holland	14
Van Buren County:	
June 13–July 14—	
South Haven	35
Mich., State total	387
MINNESOTA.	
Hennepin County:	
July—	
Minneapolis	13
Minn., State total	13
MISSISSIPPI.	
Covington County:	
Mar. 15–May 22—	
Sanford	67
Hinds County:	
April—	
Jackson	46
Holmes County:	
Apr. 20–May 8—	
Durant	13
Lauderdale County:	
Apr. 19–May 20—	
Russell	17
Madison County:	
Apr. 21–May 13—	
Madison	12
Ridgeland	5
Pike County—	
Apr. 15–May 18—	
Osyka	21
Miss., State total	181
MISSOURI.	
Barry County:	
May 18–June 8—	
Butterfield	60
Monett	96
Purdy	39
Wayne	3
Wheaton	21
Buchanan County:	
May 31–June 12—	
St. Joseph	11
Christian County:	
May 25–June 4—	
Billings	8
Greene County:	
May 22–June 8—	
Republic	34
Jasper County:	
May 22–June 15—	
Carthage	8
Sarcoxie	157
Lawrence County:	
May 22–June 11—	
Logan	43
Marionville	15
Mt. Vernon	1
Pierce City	60
Verona	19
McDonald County:	
May 15–June 3—	
Anderson	174
Goodman	36
Newton County:	
May 18–June 3—	
Neosha	262
Racine	9
Seneca	12
Stark City	12
MISSOURI—Continued.	
St. Louis City:	
May 18–29—	
St. Louis	2
Stone County:	
May 28–June 7—	
Hurley	6
Mo., State total	1,088
NEBRASKA.	
Hall County:	
May 13—	
Grand Island	1
Nemaha County:	
May 29–June 6—	
Brownville	8
Nebr., State total	9
NEW JERSEY.	
Atlantic County:	
June 2–30—	
Cologne	23
Egg Harbor	12
Hammonton	75
Landisville	61
Richland	12
Wheat Road	24
Camden County:	
June 2–July 19—	
Elm	140
Cape May County:	
June 12–23—	
Belleplain	20
Cumberland County:	
May 25–Aug.—	
Bridgeton	9
Cedarville	83
Fairton	26
Greenwich	16
Leesburg	10
Mauricetown	35
Newport	37
Port Norris	84
Rosenhayn	72
South Vineland	3
Vineland	2
Woodruff's	10
Monmouth County:	
June 5–July 7—	
Freehold	28
Keansburg	10
Matawan	6
Salem County:	
June 4–July 6—	
Norma	38
Pedricktown	7
N. J., State total	843
NEW YORK.	
Columbia County:	
June 23–July 18—	
Germantown	34
Hudson	2
Linlithgo	10
Erie County:	
June 23—	
Angola	47
Orange County:	
June 20–July 4—	
Cedar Cliff	6
Roseton	4
Oswego County:	
June 29–July 19—	
Mexico	5
New Haven	20
North Scriba	39
Oswego	27
Scriba	39

BERRIES—Continued.

Table 36.—STRAWBERRIES—Continued.

NEW YORK—Continued.

	Cars.
Ulster County:	
June 19–July 7—	
Highland	49
Marlboro	21
Milton	32
Ulster Park	2
N. Y., State total	337

NORTH CAROLINA.

Bladen County:	
Apr. 25–May 19—	
Abbottsburg	4
Bladensboro	10
Columbus County:	
Apr. 20–May 30—	
Chadbourn	210
Clarendon	16
Mt. Tabor	161
Whiteville	37
Duplin County:	
Apr. 25–May 27—	
Rose Hill	92
Teacheys	75
Wallace	24
Edgecombe County:	
May 27—	
Rocky Mount	1
Moore County:	
June 5—	
Aberdeen	1
Pender County:	
Apr.–May—	
Rocky Point	38
Willard	6
Wayne County:	
Apr. 5–May 22—	
Mt. Olive	90
N. C., State total	765

OHIO.

Columbiana County:	
June 19–July 7—	
Leetonia	13
Cuyahoga County:	
June 15—	
Cleveland	1
Hamilton County:	
June 6–Aug. 14—	
Cincinnati	30
Lake County:	
June—	
Perry	3
Washington County:	
June 13—	
Marietta	1
Ohio, State total	48

OREGON.

Hood River County:	
June 3–July 13—	
Hood River	109
Oreg., State total	109

PENNSYLVANIA.

Erie County:	
June 15–July 10—	
North East	39
Mercer County:	
June 22–July 8—	
Stoneboro	28
Pa., State total	67

SOUTH CAROLINA.

	Cars.
Horry County:	
Apr. 21–May 27—	
Loris	56
S. C., State total	56

TENNESSEE.

Blount County:	
May 27–June 1—	
Armona	4
Carroll County:	
May 8–23—	
Trezevant	38
Chester County:	
May 10—	
Henderson	1
Crockett County:	
May 4–29—	
Alamo	5
Bells	60
Friendship	5
Fruitvale	19
Gadsden	56
Davidson County:	
May 17–June 6—	
Nashville	31
Dickson County:	
May 18—	
Dickson	1
Dyer County:	
May 6–25—	
Newbern	20
Gibson County:	
May 1–30—	
Bradford	28
Dyer	71
Fruitland	19
Gibson	23
Humboldt	329
Medina	76
Milan	42
Rutherford	23
Trenton	14
Hamilton County:	
May 6–29—	
Bakewell	27
Boyce	17
Chattanooga	8
Sale Creek	32
Hardeman County:	
May 4–18—	
Grand Junction	62
Haywood County:	
May 6–31—	
Brownsville	19
Henderson County:	
May 8–13—	
Luray	5
Knox County:	
May 17–June 5—	
Knoxville	32
Lauderdale County:	
May 2–28—	
Curve	90
Gates	115
Halls	67
Ripley	103
Madison County:	
May 4–24—	
Jackson	103
Morgan County:	
May 24–June 10—	
Lancing	12
Obion County:	
May 10–June 2—	
Gibbs	5
Kenton	26
Obion	26
Union City	50

TENNESSEE—Continued.

	Cars.
Rhea County:	
May 6–June 22—	
Dayton	164
Evansville	94
Graysville	2
Sheffield	21
Spring City	145
Sumner County:	
May 23–June 10—	
Hendersonville	190
Portland	22
Tipton County:	
Apr. 15–May 23—	
Atoka	11
Covington	19
Weakley County:	
May 8–23—	
Dresden	20
Gleason	5
Greenfield	49
Sharon	100
Tenn., State total	2,506

TEXAS.

Brazoria County:	
Mar. 18–25—	
Alvin	4
Dallas County:	
May 29–June—	
Dallas	2
Dimmit County:	
Apr. 6–23—	
Carrizo Springs	44
Harris County:	
Mar. 15–May 8—	
Pasadena	17
Marion County:	
Apr. 19–May 24—	
Jefferson	13
North Jefferson	13
Smith County:	
Apr. 18–22—	
Lindale	3
Tyler	6
Wood County:	
Apr. 18–May 7—	
Winnsboro	13
Tex., State total	115

VIRGINIA.

Accomac County:	
May 1–June 18—	
Bloxom	2
Hallwood	5
Keller	24
Le Cato	3
Makemie Park	9
Mason	2
Mears	18
Melfa	15
Onley	73
Painter	13
Parksley	7
Tasley	15
Montgomery County:	
May 20–June 25—	
Christiansburg	8
Norfolk County:	
May 8–July 19—	
Fentress	4
Norfolk	653
Port Norfolk	40
Portsmouth	20
Princess Anne County:	
May—	
London Bridge	12
Princess Anne	5
Pungo	4

BERRIES—Continued.

Table 36.—STRAWBERRIES—Continued.

VIRGINIA—Continued.

	Cars.
May–June:	
Occohannock River landings	1
Potomac River landings	5
Rappahannock River landings	9
Eastern Shore points by boat to Crisfield, Md	19
Va., State total	966

WASHINGTON.

Benton County:	
June 1–30—	
Kennewick	25
King County:	
June 1–10—	
Auburn	2
Seattle	4

WASHINGTON—Continued.

	Cars.
Spokane County:	
June 19–July 12—	
Spokane	53
Wash., State total	84

WEST VIRGINIA.

Wood County:	
May 11–22—	
Parkersburg	2
W. Va., State total	2

WISCONSIN.

Bayfield County:	
July 7–24—	
Bayfield	5
Washburn	4

WISCONSIN—Continued.

	Cars.
Door County:	
July 6–20—	
Sturgeon Bay	10
Monroe County:	
June 14–July 7—	
Sparta	4
Pierce County:	
July—	
River Falls	1
Racine County:	
June 25–July 17—	
Racine	46
St. Croix County:	
June 30–July 20—	
New Richmond	4
Wis., State total	74

Table 37.—MIXED BERRIES.

ARKANSAS.

	Cars.
Lawrence County:	
July 1–Aug. 31—	
Portia	48
Ark., State total	48

CALIFORNIA.

Los Angeles County:	
Nov. 1—	
Los Angeles	1
Sonoma County:	
May 28—	
Sebastopol	1
Cal., State total	2

COLORADO.

Denver County:	
July 13–30—	
Denver	6
Colo., State total	6

KANSAS.

Doniphan County:	
June 3—	
Wathena	5
Kans., State total	5

MARYLAND.

Baltimore City:	
June 1–July 16—	
Baltimore	5
Md., State total	5

MICHIGAN.

Kent County:	
Oct. 11—	
Grand Rapids	1

MICHIGAN—Continued.

	Cars.
Muskegon County:	
July 26–Aug. 2—	
Michillinda	1
Oceana County:	
July 25–Aug. 23—	
Shelby	2
Ottawa County:	
July 19–Aug. 4—	
Grand Haven	4
Mich., State total	8

NEW JERSEY.

Atlantic County:	
July 10–Aug. 15—	
Hammonton	14
Camden County:	
July 25–Sept. 21—	
Elm	9
Cumberland County:	
June 2—	
Cedarville	1
Monmouth County:	
July 21–Aug. 30—	
Freehold	31
N. J., State total	55

NEW YORK.

Chautauqua County:	
July 24–27—	
Dunkirk	4
Irving	3
Columbia County:	
July 22–24—	
Germantown	3
Oswego County:	
July 31–Aug. 1—	
New Haven	2
N. Y., State total	12

OHIO.

	Cars.
Hamilton County:	
June—	
Cincinnati	1
Ohio, State total	1

PENNSYLVANIA.

Philadelphia County:	
June–July—	
Philadelphia	10
Pa., State total	10

TEXAS.

Haskell County:	
Aug. 23—	
Rochester	12
Smith County:	
Mar.–Apr.—	
Lindale	7
Tex., State total	19

VIRGINIA.

New Kent County:	
Aug. 20–Sept. 8—	
Windsor Shades	3
Va., State total	3

WASHINGTON.

Pierce County:	
July–Aug. 19—	
North Puyallup	1
Puyallup	1
Wash., State total	2

BERRIES—Continued.

Table 38.—CURRANTS.

MICHIGAN.	Cars.
Mason County:	
Aug. 14—	
Ludington	1
Oceana County:	
July 25–28—	
Shelby	1
Mich., State total	2

NEW YORK.	
Columbia County:	
July 15—	
Germantown	1

NEW YORK—Continued.	Cars.
Livingston County:	
July 15–20—	
Mount Morris	2
New York County:	
Jan. 1–Oct. 16—	
New York	[1] 49
Orange County:	
July 5–Aug. 10—	
Cedar Cliff	9
Roseton	15
Oswego County:	
July—	
Oswego	5
Richmond County:	
Jan. 4–Oct. 27—	
St. George Lighterage	[1] 6

NEW YORK—Continued.	Cars.
Ulster County:	
July 4–Aug. 10—	
Highland	18
Marlboro	40
Milton	15
Ulster Park	17
N. Y., State total	177

WISCONSIN.	
Door County:	
July 20–30—	
Sturgeon Bay	7
Wis., State total	7

CUCURBITOUS CROPS.

Table 39.—CANTALOUPES.

ARIZONA.	Cars.
Maricopa County:	
June 27–Aug. 8—	
Glendale	362
Mesa	24
Phoenix	105
Ariz., State total	491

ARKANSAS.	
Crawford County:	
July 10–Aug. 25—	
Alma	10
Mountainburg	14
Rudy	1
Van Buren	57
Hempstead County:	
July 1–Aug. 11—	
Belton	37
Blevins	97
Deanyville	45
Dotson	45
McCaskill	61
Shady Grove	21
Tokio	27
Washington	18
Howard County:	
July–Aug.—	
Mineral Springs	10
Nashville	66
Johnson County:	
June 5–July 18—	
Coal Hill	1
Hartman	1
Lawrence County:	
July 25–31—	
Walnut Ridge	4
Nevada County:	
July 11–20—	
Emmet	13
Pike County:	
July 13–26—	
Delight	13
Highland	1
Polk County:	
July—	
Granniss	5
Sebastian County:	
July 31—	
Hackett	1
Sevier County:	
July 9–31—	
De Queen	8
Gillham	4
Horatio	156
Ark., State total	716

CALIFORNIA.	Cars.
Alameda County:	
Sept. 4—	
Oakland	1
Fresno County:	
July 27—	
Gravel	1
Imperial County:	
May 16–July 22—	
Brawley	2,260
Calexico	587
Calipatria	121
Heber	1,215
Imperial	249
Los Angeles County:	
June 12–Aug. 18—	
Los Angeles	10
Marin County:	
Aug. 5—	
Ignacio	1
Merced County:	
July 29–Sept. 16—	
Le Grand	49
Riverside County:	
June 9–July 4—	
Coachella	21
Sacramento County:	
June 19—	
Sacramento	1
San Francisco County:	
June 15—	
San Francisco	1
Stanislaus County:	
July 10–Oct. 7—	
Denair	364
Gilman	22
Keyes	533
Modesto	1
Turlock	2,489
Cal., State total	7,926

COLORADO.	
Bent County:	
Aug. 23–Sept. 16—	
Las Animas	17
Crowley County:	
Aug. 18–Sept. 29—	
Ordway	470
Denver County:	
Aug.—	
Denver	6
Mesa County:	
Sept. 7–18—	
Clifton	4
Grand Junction	1

COLORADO—Continued.	Cars.
Otero County:	
Aug. 16–Nov. 3—	
Cheraw	1
La Junta	4
Manzanola	7
Rocky Ford	826
Swink	471
Colo., State total	1,807

DELAWARE.	
Sussex County:	
July 27–Sept. 11—	
Bridgeville	311
Cannon	28
Delmar	104
Laurel	187
Lincoln City	2
Milton	8
Oak Grove	11
Seaford	254
Del., State total	905

FLORIDA.	
Alachua County:	
June 12–28—	
Clyatt	1
Gainesville	12
Trenton	12
Gadsden County:	
June 28—	
Gretna	1
Marion County:	
June 13–July 1—	
Anthony	31
Kendrick	5
Ocala	6
Sparr	25
Sumter County:	
June 8—	
Oxford	1
Fla., State total	94

GEORGIA.	
Bacon County:	
June 22–30—	
Rockingham	5
Ben Hill County:	
June 24–Aug. 2—	
Fitzgerald	102
Berrien County:	
July—	
Rays Mill	2

[1] Probably including some dried currants.

CUCURBITOUS CROPS—Continued.

Table 39.—CANTALOUPES—Continued.

GEORGIA—Continued.

	Cars.
Brooks County:	
June—	
Morven	24
Coffee County:	
June 22–July 17—	
Douglas	24
Colquitt County:	
June 30–July 20—	
Moultrie	11
Norman Park	8
Dougherty County:	
June 17–24—	
Albany	7
Fulton County:	
June 16—	
Atlanta	1
Houston County:	
June—	
Byron	1
Irwin County:	
June—	
Osierfield	9
Lowndes County:	
June 12–July 17—	
Lake Park	4
Valdosta	89
Mitchell County:	
June 21–July 19—	
Camilla	133
Flint	14
Sale City	9
Stewart County:	
July 20—	
Renfroe	1
Thomas County:	
June–July 15—	
Coolidge	9
Meigs	21
Thomasville	27
Tift County:	
June 24–July 7—	
Tifton	17
Turner County:	
June–July—	
Dakota	11
Worth County:	
June–Aug.—	
Oakfield	3
Sylvester	30
Ga., State total	562

ILLINOIS.

Cook County:	
June 28–Oct. 23—	
Chicago	22
Madison County:	
Aug. 6—	
Poag	1
Union County:	
July 17–Aug. 19—	
Anna	15
Balcom	100
Dongola	4
Ill., State total	142

INDIANA.

Daviess County:	
Aug.—	
Washington	1
Gibson County:	
July 24–Aug. 20—	
Johnson	105
Patoka	32
Princeton	2
Jackson County:	
Aug.7–Sept. 6—	
Brownstown	47
Reddington	24
Vallonia	30

INDIANA—Continued.

	Cars.
Knox County:	
July 20–Sept. 13—	
Decker	150
Oaktown	46
Vincennes	453
Marion County:	
Aug. 5–25—	
Indianapolis	3
Owen County:	
Sept. 8–18—	
Gosport	2
Posey County:	
July 20–Aug. 30—	
New Harmony	19
Poseyville	112
Sullivan County:	
Aug. 1–Sept. 11—	
Carlisle	44
Ind., State total	1,070

IOWA.

Blackhawk County:	
Aug.—	
Waterloo	2
Muscatine County:	
Aug. 7–Sept. 28—	
Cone	1
Fruitland	26
Muscatine	22
Scott County:	
July—	
Davenport	1
Wapello County:	
June 4–July 19—	
Ottumwa	2
Iowa, State total	54

MARYLAND.

Baltimore City:	
June–Sept. 7—	
Baltimore	178
Caroline County:	
July 26–Aug.—	
Federalsburg	84
Preston	13
Ridgely	2
Dorchester County:	
Aug. 1–Sept. 2—	
East New Market	40
Ellwood	4
Hurlock	174
Rhodesdale	29
Williamsburg	3
Queen Annes County:	
Aug. 29–Sept. 28—	
Love Point	3
Somerset County:	
Aug. 2–14—	
Eden	3
Loretto	2
Talbot County:	
July 31–Aug. 28—	
Claiborne	22
Wicomico County:	
July 12–Aug. 28—	
Byrds	41
Fruitland	116
Fulton	320
Parsonsburg	5
Salisbury	146
Walstons	8
Worcester County:	
Aug.—	
Pocomoke	5
July–Aug. 24:	
Choptank River landings	33

MARYLAND—Continued.

	Cars.
July–Aug. 17:	
Nanticoke River landings	4
July 31–Aug. 15:	
Potomac River landings	6
July–Aug. 17:	
Wicomico River landings	3
Md., State total	1,244

MASSACHUSETTS.

Suffolk County:	
Aug. 16—	
Boston	1
Mass., State total	1

MICHIGAN.

Berrien County:	
Aug. 25—	
Benton Harbor	1
St. Joseph County:	
Aug.–Sept.—	
Constantine	4
Three Rivers	33
Mich., State total	38

MINNESOTA.

Ramsey County:	
Sept. 8—	
St. Paul	2
Minn., State total	2

MISSOURI.

Scott County:	
July 20–Aug. 4—	
Brooks Junction	2
Morley	17
Mo., State total	19

NEBRASKA.

Hall County:	
July—	
Grand Island	1
Nebr., State total	1

NEVADA.

Clark County:	
July 15–Aug. 15—	
Moapa	250
Nev., State total	250

NEW JERSEY.

Gloucester County:	
Aug.–Sept.—	
Mickleton	3
Mullica Hill	5
Swedesboro	86
Woodbury	12
Monmouth County:	
Sept. 12—	
Freehold	1
N. J., State total	107

CUCURBITOUS CROPS—Continued.

Table 39.—CANTALOUPES—Continued.

	Cars.
NEW MEXICO.	
Dona Ana County:	
Aug. 5–Sept. 5—	
Las Cruces	58
Guadalupe County:	
Aug. 25–Sept. 13—	
Fort Sumner	5
N. Mex., State total	63
NEW YORK.	
Chemung County:	
Aug. 12—	
Elmira	1
Erie County:	
Aug. 1—	
Buffalo	1
New York County:	
Sept. 28—	
New York City	1
Onondaga County:	
Aug. 14–Sept. 13—	
Syracuse	3
N. Y., State total	6
NORTH CAROLINA.	
Cumberland County:	
July 12–Aug. 1—	
Clifton	1
Fayetteville	21
Duplin County:	
July 8–29—	
Calypso	200
Faison	83
Moore County:	
July—	
Aberdeen	15
Robeson County:	
July 12–Aug. 5—	
Elrod	2
Lumberton	5
Maxton	33
Sandy	2
Scotland County:	
July 6–28—	
Carmichael	5
Elmore	79
Gibson	89
Hasty	66
Johns	66
Laurinburg	295
Wagram	11
Warren County:	
July 20–Aug. 8—	
Ridgeway	49
Wayne County:	
July 6–26—	
Dudley	12
Mt. Olive	107
N. C., State total	1,141
OHIO.	
Cuyahoga County:	
June 19–Sept. 20—	
Cleveland	7
Franklin County:	
July—	
Columbus	6
Hamilton County:	
June 16–Sept. 6—	
Cincinnati	4
Ohio, State total	17
OKLAHOMA.	
Texas County:	
Sept. 24–Dec. 16—	
Tyrone	4
Okla., State total	4
OREGON.	
Multnomah County:	
June 8–Aug. 25—	
East Portland	8
Portland	2
Oreg., State total	10
PENNSYLVANIA.	
Lackawanna County:	
July–Aug.—	
Scranton	16
Philadelphia County:	
July–Aug.—	
Philadelphia	63
Pa., State total	79
SOUTH CAROLINA.	
Bamberg Co.:	
July 1–8—	
Govan	4
Barnwell County:	
June 9–July 30—	
Barnwell	5
Blackville	78
Kline	12
Beaufort County:	
May 20–July 15—	
Port Royal	3
Charleston County:	
June 10—	
Charleston	1
S. C., State total	103
TENNESSEE.	
Gibson County:	
Aug.—	
Humboldt	2
Maury County:	
Aug. 1–17—	
Pleasant Grove	28
Shelby County:	
July 22—	
Memphis	1
Tenn., State total	31
TEXAS.	
Colorado County:	
July—	
Eagle Lake	35
Dallas County:	
Oct.—	
Dallas	1
Eastland County:	
July 18–Aug. 2—	
Rising Star	7
El Paso County:	
Aug. 23–30—	
Ysleta	6
TEXAS—Continued.	
Fort Bend County:	
June 27–July 17—	
Rosenburg	10
Galveston County:	
June 20–July 3—	
Dickinson	5
Hitchcock	9
Hopkins County:	
July 13–18—	
Pickton	2
Milam County:	
July 4—	
Rockdale	1
Tarrant County:	
June 22–Sept. 11—	
Fort Worth	3
Waller County:	
July 20—	
Hempstead	1
Tex., State total	80
UTAH.	
Salt Lake County:	
Aug. 15—	
Salt Lake City	1
Utah, State total	1
VIRGINIA.	
Gloucester County:	
July 20–Aug. 4—	
Allmond	3
Claybank	2
Clements Wharf	1
King William County:	
July 28–Aug. 4—	
West Point	2
Norfolk County:	
July 7–Aug. 15—	
Norfolk	43
York County:	
Aug. 6–11—	
Yorktown	2
July 31–Aug. 15:	
Potomac River landings	7
Va., State total	60
WASHINGTON.	
Spokane County:	
Sept. 5—	
Spokane	1
Yakima County:	
Aug. 26–Oct. 17—	
Donald	1
Grandview	15
North Yakima	17
Sunnyside	3
Toppenish	66
Wapato	192
Wash., State total	295
WEST VIRGINIA.	
Ohio County:	
July 24–Aug. 22—	
Wheeling	2
W. Va., State total	2

CUCURBITOUS CROPS—Continued.

Table 40.—CASABAS.

CALIFORNIA.

	Cars.
Los Angeles County:	
Sept. 13–Nov. 20—	
El Monte	2
Gardena	1
Hobart	1
Kester	9
Lankershim	32
Los Angeles	4
Newmark	1
Van Nuys	12
Orange County:	
Aug. 3–Oct. 20—	
Placentia	30

CALIFORNIA—Continued.

	Cars.
San Joaquin County:	
Nov. 17—	
Stockton	1
Stanislaus County:	
Aug. 18–Nov. 27—	
Keyes	41
Turlock	235
Cal., State total	369

WASHINGTON.

	Cars.
Yakima County:	
Sept. 23–25—	
Toppenish	2
Wash., State total	2

Table 41.—CUCUMBERS.

ALABAMA.

	Cars.
Baldwin County:	
May 25–June 26—	
Foley	3
Loxley	1
Silverhill	73
Ala., State total	77

CALIFORNIA.

Alameda County:	
June 5–6—	
Oakdale	2
Imperial County:	
May 27–31—	
Heber	1
Los Angeles County:	
May 2–Dec. 8—	
El Monte	1
Hynes	39
Long Beach	12
Los Angeles	2
Rivera	1
San Pedro	2
Vernondale	2
Cal., State total	62

DELAWARE.

Sussex County:	
June 31–Aug. 11—	
Cannon	25
Delmar	72
Laurel	31
Seaford	86
Del., State total	214

FLORIDA.

Alachua County:	
May 16–June 10—	
Archer	42
Cannons	1
Hart	12
Flewellen	1
Gainesville	47
Rocky Point	16
Waahoota	9
De Soto County:	
May 15–31—	
Wauchula	25
Hillsborough County:	
Apr. 24–May 25—	
Plant City	12
Lake County:	
May–June—	
Leesburg	29
Lisbon	5
Levy County:	
May 1–July 20—	
Morriston	1
Williston	196

FLORIDA—Continued.

	Cars.
Manatee County:	
Mar. 22–May 2—	
Ellenton	1
Parish	1
Marion County:	
May 18–June 6—	
Reddick	3
Orange County:	
Apr. 1–May 20—	
Oakland	45
Winter Garden	30
Seminole County:	
May 8—	
Sanford	1
Sumter County:	
Apr. 7–May 20—	
Bushnell	41
Sumterville	15
Webster	80
Fla., State total	613

GEORGIA.

Chatham County:	
April—	
Savannah	1
Ga., State total	1

ILLINOIS.

Champaign County:	
July 29—	
Champaign	1
Cook County:	
Aug. 22–Sept. 7—	
Globe	3
St. Clair County:	
June 19–23—	
East St. Louis	2
Union County:	
June 20–Aug. 12—	
Anna	17
Balcom	55
Dongola	117
Mill Creek	20
Ill., State total	215

INDIANA.

Kosciusko County:	
Aug.–Sept.—	
Atwood	7
Mentone	7
Ind., State total	14

KENTUCKY.

Jefferson County:	
July 26–29—	
Louisville	1
Ky., State total	1

LOUISIANA.

	Cars.
Orleans Parish:	
May 1–June 12—	
New Orleans	30
La., State total	30

MARYLAND.

Baltimore City:	
June 9–Aug. 2—	
Baltimore	77
Caroline County:	
July 13–20—	
Federalsburg	5
Somerset County:	
July 1–Aug. 10—	
Eden	4
Loretto	1
Wicomico County:	
June 1–Aug. 12—	
Byrds	93
Fruitland	34
Fulton	17
Salisbury	71
Md., State total	302

MASSACHUSETTS.

Franklin County:	
Aug. 26—	
South Deerfield	1
Mass., State total	1

MICHIGAN.

Barry County:	
Aug. 22–Sept. 9—	
Doster	5
Bay County:	
Aug. 1–15—	
Bay City	2
Grand Traverse County:	
Nov. 15—	
Kingsley	1
Kent County:	
May 4–Dec.—	
Fisher	10
Grand Rapids	15
McCords	4
Lapeer County:	
Jan. 14—	
Lum	1
Montcalm County:	
Oct. 12–17—	
Sheridan	9
Muskegon County:	
June 20–Oct. 3—	
Muskegon	16
Newaygo County:	
July—	
Newaygo	3

CUCURBITOUS CROPS—Continued.

Table 41.—CUCUMBERS—Continued.

MICHIGAN—Continued.

	Cars.
Ottawa County:	
Aug. 11–Sept. 16—	
Grand Haven	4
Van Buren County:	
July 8–Oct. 14—	
Bangor	3
McDonald	7
South Haven	3
Wayne County:	
Dec. 8—	
Detroit	1
Mich., State total	84

MINNESOTA.

Ramsey County:	
July 11–Nov. 23—	
St. Paul	13
Minn., State total	13

MISSOURI.

Greene County:	
Aug. 21–30—	
Springfield	3
Jackson County:	
June—	
Kansas City	1
Putnam County:	
July—	
Unionville	3
St. Louis City:	
July 12—	
St. Louis	1
Mo., State total	8

NEW JERSEY.

Atlantic County:	
July 16–Aug. 21—	
Landisville	14
Gloucester County:	
July 2–Aug. 30—	
Malaga	14
Newfield	26
Mercer County:	
Aug. 1–14—	
Hightstown	14
Monmouth County:	
July 14–Aug. 18—	
Freehold	86
N. J., State total	154

NEW YORK.

Erie County:	
Aug. 30–Sept. 30—	
Buffalo	2
Orchard Park	42
Nassau County:	
Aug. 7–Oct. 24—	
Central Park	4
Syosset	12
New York County:	
June 15–28—	
New York City	3
Suffolk County:	
Aug. 17–Oct. 20—	
Greenlawn	1
Greenport	3
Northport	1
Orient	59
Shelter Island	19
N. Y., State total	146

NORTH CAROLINA.

	Cars.
Columbus County:	
June 12–30—	
Chadburn	30
Duplin County:	
June 13–July 10—	
Calypso	10
Faison	43
Edgecombe County:	
June 13–22—	
South Rocky Mount	6
New Hanover County:	
June—	
Castle Hayne	15
Wilmington	58
Pender County—	
June 12–24—	
Rocky Point	18
Sampson County:	
June 23—	
Parkersburg	1
Scotland County:	
June 17–21—	
John	3
Wayne County:	
June 17–July 5—	
Mt. Olive	11
N. C., State total	195

OHIO.

Ashtabula County:	
June 2–Aug. 6—	
Ashtabula	65
Cuyahoga County:	
June 22–July 10—	
Cleveland	4
Lucas County:	
Sept. 9—	
Olive Street Junction	1
Toledo	1
Washington County:	
July 14–Aug. 7—	
Lowell	4
Marietta	1
Ohio, State total	76

OREGON.

Multnomah County:	
May 4—	
East Portland	2
Oreg., State total	2

PENNSYLVANIA.

Allegheny County—	
Aug. 21—	
Pittsburgh	1
Philadelphia County—	
June 12–July 28—	
Philadelphia	11
Pa., State total	12

SOUTH CAROLINA.

Barnwell County—	
June 3–24—	
Blackville	44
Robbins	1
Beaufort County—	
May 15–June 30—	
Port Royal	10
Sheldon	2

SOUTH CAROLINA—Contd.

	Cars.
Charleston County—	
May 25–June 30—	
Adams Run	2
Charleston	304
John's Island	14
St. Andrews	107
Yonge's Island	1
Colleton County:	
June 10–23—	
Green Pond	2
Florence County:	
May 16–June 16—	
Lake City	19
Williamsburg County:	
June 19–22—	
Cades	2
S. C., State total	508

TEXAS.

Cameron County:	
June—	
Brownsville	2
Dallas County:	
June—	
Dallas	1
Fort Bend County—	
June 9–July 5—	
Sugar Land	6
Galveston County:	
June 8–14—	
Arcadia	6
Harris County:	
May–June 21—	
Houston	2
Webster	8
Lavaca County:	
June 7–July 1—	
Sublime	8
Liberty County:	
July 29–Aug. 5—	
Liberty	2
Tex., State total	35

UTAH.

Davis County:	
Sept. 10–30—	
Layton	3
Utah, State total	3

VIRGINIA.

Elizabeth City County:	
June 26–July 11—	
Old Point Comfort	2
Norfolk County:	
May 14–Aug. 2—	
Fentress	6
Norfolk	691
Pinner's Point	1
Port Norfolk	31
Portsmouth	14
Princess Anne County:	
July 6–11—	
London Bridge	3
Virginia Beach	3
Va., State total	751

WISCONSIN.

Adams County:	
Oct. 1–Dec. 29—	
Holmesville	6
Columbia County:	
Sept. 16–Oct. 27—	
Portage	5

CUCURBITOUS CROPS—Continued.

Table 41.—CUCUMBERS—Continued.

WISCONSIN—Continued.

	Cars.
Marquette County:	
Aug. 22–Sept. 2—	
Montello	2
Monroe County:	
Aug.—	
Warren	1
Oconto County:	
Oct. 3—	
Stiles Junction	1

WISCONSIN—Continued.

	Cars.
Portage County:	
Aug.–Sept. 26—	
Junction City	3
Rosholt	1
Waupaca County:	
Sept. 30–Oct. 19—	
Iola	1
Waupaca	1

WISCONSIN—Continued.

	Cars.
Waushara County:	
Oct. 12—	
Wild Rose	1
Wood County:	
Aug. 25–Oct. 29—	
Milladore	13
Wis., State total	35

Table 42.—PUMPKINS.

ILLINOIS.

	Cars.
Cook County:	
Oct. 7—	
Lansing	1
Stephenson County:	
Oct. 14—	
Bolton	1
Ill., State total	2

INDIANA.

Bartholomew County:	
Oct. 2–27—	
Columbus	7
Clark County:	
Oct. 12–15—	
Borden	3
Gibson County:	
Sept. —	
Hazelton	1
Princeton	2
Greene County:	
Sept. 30–Oct. 18—	
Worthington	22
Hancock County:	
Oct. 15—	
Charlottesville	1
Hendricks County:	
Oct. 4–14—	
Clayton	6
Johnson County:	
Sept. 26–Oct. —	
Bargersville	6
Edinburg	24
Frances	8
Knox County:	
Oct. 11–17—	
Bicknell	1
Edwardsport	2
Lawrence County:	
Oct. 26—	
Rivervale	1
Marion County:	
Oct. 22—	
Camby	1
Morgan County:	
Sept. 6–Oct. 28—	
Brooklyn	1
Martinsville	7
Mooresville	2
Paragon	8
Shelby County:	
Oct. 3–25—	
Firland	17
Sullivan County:	
Oct. 6—	
Merom	1

INDIANA—Continued.

	Cars.
Whitley County:	
Oct. 21—	
Churubusco	1
Ind., State total	122

IOWA.

Muscatine County:	
Oct. 12–Nov. 5—	
Ardon	2
Fruitland	2
Polk County:	
Oct. 27–30—	
Clive	2
Iowa, State total	6

KANSAS.

Douglas County:	
Oct. 10–23—	
Lawrence	2
Kans., State total	2

MICHIGAN.

Antrim County:	
Nov. 2—	
Alden	1
Montcalm County—	
Oct. 1 —	
Edmore	1
Mich., State total	2

MINNESOTA.

Lesueur County:	
Oct. 7—	
Waterville	3
Minn., State total	3

NEBRASKA.

Morrill County:	
Oct.—	
Bridgeport	1
Nebr., State total	1

NEW JERSEY.

	Cars.
Burlington County:	
Oct. 4—	
Stevens	1
Cumberland County:	
Oct. 3–Nov. 28—	
Bridgeton	1
Husted	1
Gloucester County:	
Oct. 25—	
Swedesboro	1
Passaic County:	
Oct. 19—	
Athenia	1
Salem County:	
Oct. 5–Nov. 2—	
Pedricktown	11
Penns Grove	1
Woodstown	4
N. J., State total	21

NEW YORK.

Chenango County:	
Oct. 4–6—	
Galena	3
Madison County:	
Oct. 5–14—	
Solsville	5
Otsego County:	
Oct. 14—	
Fly Creek	1
Richfield Springs	1
Seneca County:	
Oct. 28—	
Yale	1
N. Y., State total	11

OHIO.

Lake County:	
Oct. 24—	
Madison	1
Ohio, State total	1

PENNSYLVANIA.

Columbia County:	
Nov. 1—	
Bloomsburg	1
Crawford County:	
Oct. 10—	
Millers	2
Erie County:	
Oct. 31–Nov. 4—	
Crayton	2
Pa., State total	5

CUCURBITOUS CROPS—Continued.

Table 43.—SQUASH.

	Cars.
CALIFORNIA.	
Los Angeles County:	
Mar. 29–Dec. 28—	
El Monte	1
Los Angeles	2
Cal., State total	3
COLORADO.	
Denver County:	
Oct. 23—	
Denver	1
Colo., State total	1
FLORIDA.	
Alachua County:	
June 1–25—	
Evinston	13
Duval County:	
May 7–Dec. 14—	
Jacksonville	2
Hillsborough County:	
May 2—	
Plant City	1
Marion County:	
June 3–7—	
Hickman	2
Seminole County:	
May 1–June 30—	
Sanford	6
Fla., State total	24
ILLINOIS.	
Cook County:	
Sept. 25–Dec. 12—	
Chicago	1
Dunning	3
Lansing	6
Ill., State total	10
MAINE.	
Cumberland County:	
Dec. 2–Mar. 15—	
Deering Junction	3
Portland	2
Oxford County:	
Nov. 6—	
West Bethel	1
Me., State total	6
MASSACHUSETTS.	
Hampshire County:	
Oct. 7—	
Amherst	1
Plymouth County:	
Oct. 25—	
North Carver	1
Mass., State total	2
MICHIGAN.	
Benzie County:	
Nov.—	
Honor	1
Mich., State total	1
MINNESOTA.	
Anoka County:	
Oct. 14–19—	
Twin City Stock Yards	3
Hennepin County:	
Oct. 1–Nov. 3—	
Camden Place	2
Minnehaha	3
Ramsey County:	
Sept. 16–Dec. 2—	
Minnesota Transfer	1
New Brighton	2
St. Paul	6
Wabasha County:	
Sept. 27—	
Wabasha	1
Washington County:	
Oct. 7—	
Newport	1
Minn., State total	19
NEBRASKA.	
Buffalo County:	
Nov. 20—	
Kearney	1
Nebr., State total	1
NEW JERSEY.	
Gloucester County:	
Nov. 13—	
Mickleton	1
Mercer County:	
Sept. 21—	
Yardville	1
N. J., State total	2
OHIO.	
Lucas County:	
Oct. 6—	
Toledo	1
Ottawa County:	
Oct. 1–Nov. 27—	
Curtice	10
Sandusky County:	
Oct. 19–Nov. 1—	
Clyde	2
Wayne County:	
Sept.—	
Funk	1
Ohio, State total	14
OREGON.	
Washington County:	
Jan. 26—	
Beaverton	1
Oreg., State total	1
SOUTH CAROLINA.	
Charleston County:	
May 16–June 29—	
Charleston	17
Williamsburg County:	
May 26—	
Cades	1
S. C., State total	18
UTAH.	
Box Elder County:	
Oct. 7—	
Willard	1
Weber County:	
Sept. 26–Oct. 26—	
Ogden	3
Utah, State total	4
VERMONT.	
Orleans County:	
Oct. 17—	
Orleans	1
Vt., State total	1
VIRGINIA.	
Norfolk County:	
May 8–Sept. 4—	
Norfolk	30
Port Norfolk	2
Va., State total	32
WASHINGTON.	
Benton County:	
Oct. 20–Dec. 8—	
Prosser	3
Spokane County:	
Oct. 21—	
Dishman	1
Yakima County:	
Oct. 5—	
Toppenish	1
Wash., State total	5
WISCONSIN.	
Kenosha County:	
Oct. 14–Nov. 8—	
Berryville	3
Milwaukee County:	
Oct. 5–24—	
Cudahy	2
Wis., State total	5

Table 44.—WATERMELONS.

	Cars.
ALABAMA.	
Autauga County:	
July 12–Sept. 26—	
Billingsley	7
Booth	12
Barbour County:	
July 13–Aug. 1—	
Eufaula	6
Bullock County:	
July–Sept.—	
Boswell	4
ALABAMA—Continued.	
Chilton County:	
July 16–Oct. 1—	
Clanton	8
Cooper	21
Pletcher	6
Thorsby	4
Verbena	47
Clay County:	
July–Sept.—	
Hollins	2
ALABAMA—Continued.	
Coosa County:	
Aug.–Oct.—	
Goodwater	8
Kellyton	18
Covington County:	
June 28–July 15—	
Florala	2
Gantt	2
Opp	6
Sanford	25

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

ALABAMA—Continued.

	Cars.
Dale County:	
July–Aug.—	
Midland City	9
Newton	4
Pinckard	12
Dallas County:	
July 25–30—	
Burnsville	2
Geneva County:	
June 23–July 29—	
Black	16
Geneva	8
Hartford	17
Malvern	54
Sampson	28
Slocomb	34
Houston County:	
June 22–Aug. 10—	
Alaga	22
Ardilla	8
Ashford	40
Cowarts	55
Dothan	20
Gordon	19
Pansey	12
Taylor	3
Webb	115
Mobile County:	
June 27–July 28—	
Dawes	11
Grand Bay	91
Irvington	4
St. Elmo	1
Satsuma	3
Semmes	9
Theodore	26
Wilmer	2
Montgomery County:	
July–Aug.—	
Montgomery	7
Ala., State total	810

ARIZONA.

Greenlee County:	
Sept. 2–11—	
Duncan	2
Maricopa County:	
June 17–Aug. 1—	
Glendale	32
Mesa	4
Phoenix	24
Yuma County:	
June 13–July 16—	
Yuma	32
Ariz., State total	94

ARKANSAS.

Bradley County:	
Aug. 20–28—	
Warren	2
Clay County:	
Aug.—	
Nimmons	7
Craighead County:	
July 29–Aug. 5—	
Bay	2
Herman	1
Crawford County:	
July 19—	
Rudy	1
Hempstead County:	
July—	
Blevins	34
Deanyville	13
Hope	13
Shady Grove	17
Hot Springs County:	
June 18–Sept. 2—	
Reyburn	13
Sims	4

ARKANSAS—Continued.

	Cars.
Howard County:	
July 28—	
Nashville	1
Lonoke County:	
July 20—	
Cabot	1
Miller County:	
July 18–Aug. 8—	
Texarkana	9
Nevada County:	
July—	
Arcadia	15
Ouachita County:	
July 18–Aug. 17—	
Camden	15
Randolph County:	
July—	
Biggers	25
Ark., State total	173

CALIFORNIA.

Alameda County:	
June 22–July 10—	
Oakland	3
Fresno County:	
July 11–Sept. 16—	
Fresno	53
Parlier	1
Reedley	8
Imperial County:	
May 18–July 11—	
Brawley	199
Calexico	17
El Centro	71
Heber	249
Holtville	2
Imperial	61
Rockwood	81
Los Angeles County:	
June 16–Aug. 19—	
Arcadia	1
Los Angeles	5
Redwood	2
Napa County:	
Sept. 6—	
Napa	1
Riverside County:	
May 30–July 5—	
Coachella	40
India	5
Thermal	15
Sacramento County:	
June 12—	
Sacramento	1
San Francisco County:	
June 9–30—	
San Francisco	4
San Joaquin County:	
Aug. 31–Sept. 2—	
Manteca	7
Santa Clara County:	
July 5—	
San Jose	1
Stanislaus County:	
July 9–Oct. 3—	
Denair	56
Hughson	8
Keyes	16
Turlock	43
Tulare County:	
July 2–Aug. 23—	
Cutler	10
Dinuba	10
North Dinuba	76
Sultana	101
Cal., State total	1,147

COLORADO.

	Cars.
Conejos County:	
July—	
Antonito	3
Denver County:	
June 28–Aug. 19—	
Denver	11
Otero County:	
Aug.–Sept.—	
Fowler	30
Manzanola	52
Rocky Ford	2
Swink	47
Pueblo County:	
July 20–Oct. 10—	
Nepesta	12
Pueblo	4
Weld County:	
Sept. 18—	
Greeley	1
Yuma County:	
Sept. 1–30—	
Wray	1
Colo., State total	163

DELAWARE.

Sussex County:	
Aug. 3–Sept. 9—	
Bridgeville	23
Cannon	2
Delmar	304
Georgetown	6
Laurel	431
Oak Grove	13
Seaford	69
Stockley	1
Del., State total	849

FLORIDA.

Alachua County:	
June 1–July 17—	
Alachua	21
Arredonda	12
Bell	2
Bellamy	5
Campville	6
Evinston	15
Gainesville	27
Rochelle	4
Trenton	228
Wilcox	3
Bradford County:	
June–July—	
Brooker	38
Dukes	4
Graham	7
Calhoun County:	
June 27—	
Blountstown	1
Citrus County:	
June–July—	
Floral City	9
Inverness	125
Columbia County:	
June 22–July 3—	
Fort White	8
De Soto County:	
Apr. 15–Oct. 1—	
Arcadia	1
Bowling Green	155
Fort Green	17
Fort Ogden	5
Lansing	1
Nocatee	10
Ona	18
Wauchula	36
Duval County:	
Apr.–July 15—	
Bowden	1

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

FLORIDA—Continued.

	Cars.
Escambia County:	
June 26–July 15—	
Quintette	4
Roberts	4
Hamilton County:	
June 28—	
Jennings	28
Hernando County:	
June 13–28—	
Istachatta	18
Hillsborough County:	
June—	
Dover	1
Plant City	2
Seffner	5
Holmes County:	
June 16–July 16—	
Bonifay	5
Esto	37
Noma	22
Jackson County:	
June 15–July 19—	
Cypress	7
Malone	126
Marianna	31
Sneads	35
Lake County:	
May 25–July 1—	
Altoona	50
Eustis	42
Grand Island	47
Groveland	27
Lady Lake	84
Leesburg	46
Lisbon	30
Mascotte	27
Mount Dora	18
Okahumpka	3
Sorrento	54
Whitney	20
Lee County:	
May 20–June 27—	
Fort Meyers	38
Levy County:	
June–July—	
Morriston	9
Williston	10
Madison County:	
June 22–July 13—	
Lovett	12
Manatee County:	
June–July:	
Ellenton	3
Manatee	14
Marion County:	
May 26–July 28—	
Anthony	21
Candler	13
Cara	4
Citra	1
Fairfield	7
Kendrick	13
Ocala	1
Orange Lake	22
Santos	2
South Lake Weir	40
Summerfield	19
Weirsdale	106
Orange County:	
June 1–21—	
Apopka	4
Winter Garden	4
Pasco County:	
June—	
Dade City	3
Polk County:	
May–July—	
Auburndale	25
Brewster	5
Chicora	2
Eagle Lake	4
Lakeland	25

FLORIDA—Continued.

	Cars.
Putnam County:	
June 19–July 11—	
Grandin	1
Pomona	6
Seminole County:	
June 27—	
Longwood	1
Sumter County:	
June 2–29—	
Coleman	6
Oxford	4
Panasoffkee	31
Webster	9
Wildwood	44
Suwanee County:	
June 17–July 26—	
Houston	41
Live Oak	209
McAlpin	8
O'Brien	2
Pinemount	10
Welborn	4
Volusia County:	
July 13—	
Barberville	1
Washington County:	
June 28–July 28—	
Chipley	4
Fla., State total	2,320

GEORGIA.

Baldwin County:	
July 12–Aug. 23—	
Stevens Pottery	23
Barrow County:	
Aug. 1–30—	
Winder	5
Ben Hill County:	
July 12–19—	
Fitzgerald	3
Berrien County:	
June 16–July 17—	
Adel	134
Bannockburn	5
Nashville	27
Rays Mill	15
Sparks	15
Bibb County:	
July–Aug.—	
Drybranch	47
Lizella	10
Macon	15
Macon Junction	11
Sofkee	5
Brooks County:	
June–July—	
Barney	10
Barwick	187
Morven	113
Quitman	174
Bryan County:	
June 27–Aug. 12—	
Ellabelle	3
Lanier	10
Pembroke	5
Bulloch County:	
June 21–Aug. 9—	
Alderman	7
Brooklet	155
Clito	10
Denmark	10
Harville	6
Jimps	6
Portal	2
Stilson	169
Watersville	8
Burke County:	
June 1–Aug. 27—	
Keysville	24
St. Clair	2
Stevens Crossing	7

GEORGIA—Continued.

	Cars.
Calhoun County:	
June—	
Arlington	1
Candler County:	
June–July—	
Metter	8
Chatham County:	
June–Aug. 10—	
Savannah	34
Clay County:	
June–July—	
Fort Gaines	14
Clayton County:	
June–July—	
Jonesboro	3
Coffee County:	
July—	
Douglas	22
West Green	10
Colquitt County:	
June 17–July 14—	
Berlin	54
Crosland	70
Doerun	2
Ellenton	21
Moultrie	86
Murphy	25
Norman Park	60
Ticknor	224
Columbia County:	
July 7–Sept. 4—	
Berzelia	8
Grovetown	32
Harlem	1
Crawford County:	
July 14–Aug. 31—	
Beechwood	1
Gaillard	38
Zenith	18
Crisp County:	
June–July—	
Cordele	2
Wenona	14
Decatur County:	
June 24–July 18—	
Donaldsonville	9
Eldorendo	29
Whites Mill	4
Dodge County:	
July 2–28—	
Chauncey	8
Empire	1
Gresston	3
Dooly County:	
June–July—	
Unadilla	11
Dougherty County:	
June 17–July 11—	
Albany	33
Early County:	
June–July	
Blakely	4
Corea	2
Effingham County:	
July—	
Clyo	27
Rincon	2
Emanuel County:	
July 13–Aug. 12—	
Graymont	5
Stillmore	2
Swainsboro	15
Wade	8
Evans County:	
July–Aug.—	
Belleville	4
Claxton	3
Fannin County:	
June 20–July 14—	
Maxwell	14
Fulton County:	
June 29–Aug. 22—	
Atlanta	14

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

GEORGIA—Continued.

	Cars.
Grady County:	
June 21–July 26—	
Cairo	38
Calvary	36
Pine Park	84
Whigham	3
Houston County:	
June 2–Aug. 30—	
Bonaire	54
Byron	193
Elko	10
Fort Valley	303
Grovania	8
Kathleen	30
Perry	121
Powersville	130
Wellston	35
Irwin County:	
June–July—	
Mystic	11
Wray	5
Jefferson County:	
June–July—	
Matthews	21
Jenkins County:	
July–Aug.—	
Millen	12
Perkins	2
Scarboro	2
Jones County:	
July–Aug.—	
Gray	1
Griswold	53
James	69
Laurens County:	
Aug. 1–16—	
Alcorns	3
Batson	2
Cadwell	4
Dexter	1
Dublin	1
Reutz	1
Shewmake	1
Springhaven	5
Lee County:	
July—	
Leesburg	7
Smithville	19
Lowndes County:	
June 17–July 21—	
Dasher	11
Lake Park	6
Ousley	24
Valdosta	158
McDuffie County:	
Aug. 1–23—	
Bonesville	8
Macon County:	
July 3–Aug. 30—	
Marshallville	3
Montezuma	45
Oglethorpe	198
Winchester	42
Marion County:	
July—	
Buena Vista	1
Putnam	9
Mitchell County:	
June 21–July 7—	
Camilla	48
Flint	44
Sale City	22
Pulaski County:	
July 7–8—	
Browndale	2
Richmond County:	
July–Aug. 15—	
Blyth	43
Hephzibah	23
McBean	1

GEORGIA—Continued.

	Cars.
Schley County:	
July–Aug.—	
Ellaville	54
LaCrosse	80
Screven County:	
July 5–Aug. 23—	
Cameron	5
Dover	50
Halcyondale	8
Rocky Ford	11
White Hill	4
Sumter County:	
June 15–Aug. 10—	
Americus	16
Andersonville	168
Cobb	4
Leslie	1
Plains	15
Sumter	10
Tabot County:	
July—	
Junction City	1
Taylor County:	
Aug.–Sept.—	
Butler	25
Charing	4
Reynolds	3
Telfair County:	
July 14–19—	
Helena	6
Thomas County:	
June 16–July 22—	
Boston	47
Coolidge	68
Meigs	132
Merrillville	20
Ochlocknee	75
Pavo	69
Thomasville	52
Tift County:	
June 15–July 15—	
Brookfield	12
Omega	110
Tifton	163
Ty Ty	37
Turner County:	
June–July—	
Rebecca	20
Twiggs County:	
July 26–Aug. 18—	
Fitzpatrick	9
Jeffersonville	17
Wayne County:	
July—	
Nahunta	2
Wilkinson County:	
July–Aug.—	
Gordon	123
Ivey	59
McIntyre	18
Toomsboro	16
Worth County:	
June 20–Aug. 20—	
Bridgeboro	79
Oakfield	5
Shingler	60
Sylvester	7
Ga., State total	5,787

IDAHO.

	Cars.
Ada County:	
Sept. 6—	
Boise	1
Bonneville County:	
June 25–July 5—	
Idaho Falls	2
Canyon County:	
Aug. 7–Sept. 21—	
Emmett	25
Payette	16

IDAHO—Continued.

	Cars.
Elmore County:	
Aug. 25–Sept. 18—	
King Hill	14
Nez Perce County:	
Sept. 12—	
Lewiston	1
Idaho, State total	59

ILLINOIS.

	Cars.
Bond County:	
Aug. 25—	
Greenville	1
Carroll County:	
Aug.—	
Thomson	95
Cass County:	
Aug. 1–Oct. 11—	
Arenzville	62
Beardstown	97
Bluff Springs	46
Cook County:	
Aug.—	
South Holland	1
Fulton County:	
Aug.–Sept.—	
Lewistown	2
West Havana	1
Jo Daviess County:	
Aug. 19–21—	
Whitton	2
Kankakee County:	
Sept. 1–Oct. 30—	
Momence	6
Knox County:	
Aug.—	
Galesburg	3
Lawrence County:	
Aug. 15–Oct. 1—	
Lawrenceville	3
Madison County:	
Aug. 21–Sept. 8—	
Alton	1
Poag	6
Mercer County:	
Sept. 23–Oct. 4—	
New Boston	3
Morgan County:	
Aug.—	
Meredosia	6
Peoria County:	
Sept. 7–16—	
Peoria	2
St. Clair County:	
July 21–Aug. 4—	
East St. Louis	2
Sangamon County:	
Aug. 29—	
Springfield	1
Scott County:	
Aug.—	
Naples	4
Union County:	
Aug. 6–12—	
Anna	4
White County:	
Aug. 9–Oct. 20—	
Carmi	15
Epworth	48
Maunie	35
Simpsons	4
Ill., State total	450

INDIANA.

	Cars.
Daviess County:	
Aug.—	
Plainville	2
Washington	30

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

INDIANA—Continued.

	Cars.
Gibson County:	
Aug. 7–Sept. 13—	
Hazelton	6
Johnson	37
Owensville	6
Patoka	7
Princeton	9
Jackson County:	
Aug. 14–Sept. 20—	
Brownstown	15
Seymour	3
Vallonia	33
Johnson County:	
Sept. 6—	
Edinburg	1
Knox County:	
Aug. 5–Sept. 28—	
Decker	16
Emison	35
Oaktown	35
Vincennes	50
Newton County:	
Aug.—	
Rose Lawn	1
Posey County:	
Aug. 7–Sept. 14—	
Griffin	45
New Harmony	84
Poseyville	111
Stewartsville	22
St. Joseph County:	
Aug.—	
South Bend	1
Sullivan County:	
Aug. 17–Sept. 19—	
Carlisle	62
Merom	7
New Lebanon	2
Ind., State total	620

IOWA.

Benton County:	
Aug. 29—	
Vinton	1
Blackhawk County:	
Sept. 6—	
Waterloo	1
Butler County:	
Sept. 8—	
New Hartford	1
Clarke County:	
Aug.—	
Osceola	6
Lee County:	
Sept. 5–Oct. 8—	
Fort Madison	3
Keokuk	1
Montrose	9
New Boston	3
Viele	17
Louisa County:	
Aug.–Sept.—	
Columbus Junction	10
Fredonia	10
Gladwin	1
Grandview	8
Montgomery County:	
Aug.—	
Villisca	1
Muscatine County:	
Aug. 12–Oct. 9—	
Cone	257
Cranston	10
Fruitland	105
Moscow	7
Muscatine	16
Nichols	75
Iowa, State total	542

KANSAS.

	Cars.
Cloud County:	
Aug. 5–Oct. 15—	
Clyde	32
Cowley County:	
Sept. 5–14—	
Arkansas City	2
Dickinson County:	
Aug. 3–Oct. 30—	
Abilene	10
Solomon	7
Douglas County:	
July 11—	
Lawrence	1
Johnson County:	
Aug. 30–Sept. 13—	
Wilder	4
Riley County:	
Aug.–Sept.—	
Manhattan	6
Sedgwick County:	
Aug. 12–Sept. 12—	
Haysvill	12
Wichita	1
Shawnee County:	
July 25–Sept. 30—	
North Topeka	3
Topeka	19
Kans., State total	97

KENTUCKY.

Jefferson County:	
June 24–Aug. 15—	
Louisville	3
Lewis County:	
Aug. 23—	
Garrison	1
Ky., State Total	4

LOUISIANA.

Lincoln Parish:	
July–Aug.—	
Ruston	5
Orleans Parish:	
June 26—	
New Orleans	1
St. Landry Parish:	
Aug. 19–28—	
Armandville	6
La., State total	12

MARYLAND.

Baltimore City:	
June 12–Sept. 30—	
Baltimore	247
Caroline County:	
Aug. 16—	
Federalsburg	1
Preston	5
Dorchester County:	
Aug. 8–Sept. 27—	
Airey	14
East New Market	20
Ellwood	13
Hurlock	36
Linkwood	5
Reids Grove	29
Rhodesdale	53
Vienna	116
Williamsburg	1
Wicomico County:	
Aug. 2–Sept. 12—	
Byrds	112
Fruitland	68
Fulton	46
Parsonsburg	2
Rockawalking	70
Salisbury	157
Walstons	6

MARYLAND—Continued.

	Cars.
July 26–Aug. 16:	
Choptank River landings	28
Aug. 1–Sept. 27:	
Nanticoke River landings	30
Aug. 2–Sept. 1:	
Wicomico River landings	4
Md., State total	1,063

MASSACHUSETTS.

Essex County:	
July 7—	
Lawrence	1
Mass., State total	1

MICHIGAN.

Berrien County:	
Aug.—	
Benton Harbor	1
Coloma	2
St. Joseph County:	
Aug.—	
Three Rivers	1
Mich., State total	4

MINNESOTA.

Hennepin County:	
July—	
Minneapolis	47
Ramsey County:	
July 1–Aug. 11—	
St. Paul	4
St. Louis County:	
Aug. 22—	
Duluth	1
Minn., State total	52

MISSISSIPPI.

Clarke County:	
June–July—	
Shubuta	11
Forrest County:	
June–July—	
Fruitland Park	7
McLaurin	9
Hancock County:	
June 28—	
Bay St. Louis	
Hinds County:	
July 22—	
Smiths	1
Miss., State total	29

MISSOURI.

Dunklin County:	
July 20–Sept. 6—	
Campbell	144
Clarkton	185
Frisbee	160
Gibson	172
Holcomb	395
Hornersville	20
Kennett	263
Malden	303
Jackson County:	
Aug.–Sept. 19—	
Atherton	1
Courtney	1
Kansas City	8
Mississippi County:	
July 29–Sept. 12—	
Bertrand	668
Charleston	72
East Prairie	286

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

MISSOURI—Continued.

	Cars.
Pulaski County:	
Aug. 30–Sept. 8—	
Dixon	2
Ripley County:	
July 20–Aug. 29—	
Naylor	54
St. Louis City:	
July 27–Aug. 15—	
St. Louis	3
Scott County:	
July 26–Sept. 29—	
Benton	216
Blodgett	425
Brook's Junction	97
Diehlstadt	247
McMullen	82
Morley	605
Oran	52
Sikeston	10
Vanduser	57
Stoddard County:	
July 28–Aug. 29—	
Bernie	45
Mo., State total	4,567

NEBRASKA.

Adams County:	
Sept.—	
Hastings	1
Cherry County:	
Sept. 21—	
Valentine	1
Dodge County:	
Sept.—	
Fremont	1
Douglas County:	
July—	
Omaha	1
Hall County:	
June–Sept. 19—	
Grand Island	2
Lancaster County:	
July 19–Sept. 7—	
Lincoln	2
Saunders County:	
Sept. 13—	
Leshara	1
Thayer County:	
Sept. 1–15—	
Hebron	10
Nebr., State total	44

NEVADA.

Washoe County:	
Aug.—	
Reno	1
Nev., State total	1

NEW JERSEY.

Burlington County:	
Aug.—	
Riverton	2
Cumberland County:	
Sept. 1–26—	
Mauricetown	48
Gloucester County:	
Sept. 6–27—	
Clarksboro	3
Swedesboro	6
Woodbury	1
Monmouth County:	
Aug.—	
Morganville	1

NEW JERSEY—Continued.

	Cars.
Salem County:	
Sept. 8–27—	
Pedricktown	26
Penns Grove	7
Woodstown	1
N. J., State total	95

NEW YORK.

Albany County:	
Aug.—	
Albany	1
N. Y., State total	1

NORTH CAROLINA.

Bladen County:	
July 20–Aug. 3—	
Dublin	1
Elizabethtown	1
Cumberland County:	
July 21–Aug. 1—	
Fayetteville	26
Duplin County:	
July 2–Aug. 5—	
Bowdens	1
Calypso	50
Faison	28
Henderson County:	
July—	
Hendersonville	5
Hoke County—	
July 27–Aug. 3—	
Raeford	7
Rockfish	8
Johnston County:	
July 20–Aug. 3—	
Clayton	44
Wilson's Mills	3
Moore County:	
August—	
Aberdeen	39
Robeson County:	
July 15–Aug. 28—	
Allenton	4
Buie	2
Elrod	2
Fairmont	1
Lumberton	7
Maxton	83
Parkton	24
Sandy	60
Wakulla	1
Scotland County:	
July 15–Sept. 5—	
Elmore	55
Gibson	30
Hasty	9
Johns	1
Laurinburg	226
Wagram	45
Wayne County:	
July 19–Aug. 9—	
Dudley	27
Goldsboro	18
Mount Olive	45
N. C., State total	853

OHIO.

Cuyahoga County:	
June 14–Aug.—	
Cleveland	17
Cleveland Pier	1
Franklin County:	
Aug. 16—	
Columbus	1

OHIO—Continued.

	Cars.
Lucas County:	
Aug. 17–Sept.—	
Toledo	3
Ohio, State total	22

OKLAHOMA.

Caddo County:	
July 22–Sept. 7—	
Cement	257
Canadian County:	
Aug. 1–Sept. 20—	
El Reno	4
Mustang	40
Comanche County:	
July 26–Aug. 30—	
Fletcher	30
Grady County:	
July 20–Sept. 8—	
Chickasha	48
Ninnekah	216
Norge	6
Rust Springs	552
Jefferson County:	
July–Aug.—	
Terral	237
Logan County:	
Aug. 8–Sept. 15—	
Crescent	19
McClain County:	
Aug. 12—	
Blanchard	1
McCurtain County:	
Aug. 1–28—	
Valliant	4
Oklahoma County:	
Aug. 22–Sept. 5—	
Wheatland	5
Pottawatomie County:	
June 30–Aug. 22—	
Shawnee	5
Pushmataha County:	
July 15—	
Clayton	1
Seminole County:	
Sept. 17—	
Hazel	1
Sequoyah County:	
July 3—	
Marble City	1
Stephens County:	
July 25–Aug. 16—	
Marlow	100
Okla., State total	1,527

OREGON.

Multnomah County:	
June 17–Sept. 6—	
East Portland	3
Portland	2
Oreg., State total	5

PENNSYLVANIA.

Allegheny County:	
July 19—	
Pittsburgh	1
Lackawanna County:	
July–Aug.—	
Scranton	24
Pa., State total	25

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

RHODE ISLAND.

	Cars.
Providence County:	
Sept. 6—	
Providence	1
R. I., State total	1

SOUTH CAROLINA.

Aiken County:	
July 14—Aug. 10—	
Sally	9
Windsor	8
Bamberg County:	
July 4–Aug. 25—	
Denmark	41
Govan	46
Midway	7
Barnwell County:	
June 23–Aug. 17—	
Allendale	125
Appleton	34
Barnwell	72
Barton	168
Blackville	75
Cave	45
Dunbarton	97
Elko	16
Fairfax	130
Kline	115
Martin	61
Myers Mill	97
Seigling	58
Snellings	31
Sycamore	158
Ulmers	192
Yenome	61
Hampton County:	
June 26–Aug. 8—	
Estill	284
Furman	125
Garnett	21
Gifford	50
Hampton	6
Lena	150
Scotia	157
Valentine	87
Jasper County:	
June 28–Aug. 15—	
Pineland	10
Ridgeland	79
Tarboro	8
Tillman	31
Orangeburg County:	
July—	
Copes	7
Springfield	4
S. C., State total	2,665

SOUTH DAKOTA.

Clay County:	
Aug. 26–Sept. 21—	
Vermillion	6
Minnehaha County:	
July 25—	
Sioux Falls	1
S. Dak., State total	7

TENNESSEE.

McMinn County:	
Aug.—	
Athens	4
Tenn., State total	4

TEXAS.

	Cars.
Atascosa County:	
June 28–July 25—	
Pleasanton	3
Austin County:	
July 15–Aug. 24—	
Sealy	230
Bastrop County:	
July 4–Aug. 10—	
Elgin	83
McDade	66
Bexar County:	
June–July—	
Elmendorf	24
Brooks County:	
July—	
Falfurrias	2
Callahan County:	
Aug. 6—	
Clyde	1
Cameron County:	
July—	
Brownsville	30
San Benito	1
Chambers County:	
July 1–Aug. 19—	
Stowell	73
Winnie	30
Cherokee County:	
June 20–July 20—	
Mt. Selman	20
Colorado County:	
June 30–July 13—	
Columbus	2
Comanche County:	
July 19–Aug. 13—	
Comanche	2
De Leon	4
Donley County:	
Aug. 7–Oct. 4—	
Clarendon	2
Hedley	3
Lelia Lake	13
El Paso County—	
Aug. 9–16—	
El Paso	3
Erath County:	
July 29–Sept. 1—	
Dublin	85
Stephenville	2
Fort Bend County:	
July 13–20—	
Sugar Land	3
Franklin County:	
July 19–Aug. 25—	
Mt. Vernon	41
Frio County:	
July 1–Aug. 1—	
Pearsall	9
Galveston County:	
July 1–Sept. 15—	
High Island	8
Gray County:	
Aug.–Oct.—	
McClean	53
Grayson County:	
Aug. 20–Sept. 15—	
Ambrose	4
Grimes County:	
June 28–July 29—	
Courtney	10
Navasota	112
Guadalupe County:	
June 23–July 25—	
Seguin	26
Harris County:	
July 4–Sept.—	
Almeda	3
Hockley	2
Houston	10
Hufsmith	1
Katy	21

TEXAS—Continued.

	Cars.
Haskell County:	
Aug. 5–25—	
Rochester	12
Henderson County:	
July–Aug.—	
Athens	28
Murchison	20
Hidalgo County:	
May–June—	
Mercedes	1
Mission	6
Hill County:	
July 22—	
Hubbard	1
Hopkins County:	
July–Sept. 15—	
Como	168
Pickton	5
Saltillo	5
Sulphur Springs	158
Houston County:	
July 12–Aug. 4—	
Grapeland	22
Howard County:	
Aug. 15–Oct. 28—	
Coahoma	4
Hunt County:	
July 28–Aug. 23—	
Campbell	8
Neyland	4
Jefferson County:	
July 15–Aug. 13—	
Hamshire	10
Sabine Pass	5
Jim Wells County:	
July—	
Sandia	6
Matagorda County:	
July 19–Oct. 3—	
Bay City	4
Palacios	35
Milam County:	
Aug. 15—	
Rockdale	4
Montgomery County:	
July 15–Aug. 20—	
Security	2
Willis	6
Morris County:	
July 15–Aug. 12—	
Daingerfield	3
Naples	4
Omaha	30
Nacogdoches County:	
July 18–22—	
Sacul	3
Parker County:	
July–Sept.—	
Garner	10
Weatherford	196
Rains County:	
July 17–28—	
Emory	18
Red River County:	
Aug. 1—	
Bogata	1
Runnels County:	
Aug. 26–Sept. 8—	
Ballinger	5
Rusk County:	
July 15–Aug. 5—	
Overton	26
Tarrant County:	
July 24–Aug. 15—	
Tarrant	13
Titus County:	
July 25—	
Mt. Pleasant	1
Waller County:	
June 22–Aug. 17—	
Hempstead	964
Prairie View	281
Waller	149

CUCURBITOUS CROPS—Continued.

Table 44.—WATERMELONS—Continued.

TEXAS—Continued.

	Cars.
Wichita County:	
Aug. 2–Sept. 5—	
Burkburnett	28
Wilbarger County:	
July 28–Oct. 5—	
Vernon	15
Wilson County:	
June–Aug.—	
Calaveras	36
Stockdale	19
Wise County:	
Aug. 4–Sept. 8—	
Decatur	6
Wood County:	
July—	
Golden	14
Ogburn	6
Tex., State total	3,324

UTAH.

Boxelder County:	
Aug. 22–Sept. 2—	
Brigham	8
Davis County:	
Sept. 6—	
Woods Cross	1
Emery County:	
Sept. 26—	
Green River	1
Salt Lake County:	
June 22–Aug. 29—	
Salt Lake City	6
Weber County:	
June 23–Sept. 28—	
Ogden	5
Roy	1
Utah, State total	22

VIRGINIA.

Charles City County:	
Aug. 7–Sept. 9—	
Roxbury	40

VIRGINIA—Continued.

	Cars.
Dinwiddie County:	
July 17–Sept. 7—	
Petersburg	10
Hanover County:	
Aug. 5–Sept. 16—	
Atlee	10
East Atlee	26
Hanover	5
Old Church	4
Pamunkey	9
Peake	2
James City County:	
Aug. 2–Sept. 5—	
Diascund	4
Lightfoot	3
Norge	23
Toano	80
King William County:	
July 6–Aug. 30—	
West Point	123
Nansemond County:	
July 1–Aug. 8—	
Myrtle	2
Suffolk	8
New Kent County:	
Aug.–Sept.—	
Lanexa	29
White House	2
Norfolk County:	
July 10–Sept. 20—	
Norfolk	555
Port Norfolk	302
Roanoke County:	
June 30—	
Roanoke	1
Aug. 1–Sept. 6:	
Rappahannock River landings	1
Va., State total	1,239

WASHINGTON.

Benton County:	
Aug. 12–Sept. 13—	
Kennewick	11

WASHINGTON—Continued.

	Cars.
Grant County:	
Aug.–Sept.—	
Neppel	13
King County:	
Oct. 6—	
Seattle	1
Walla Walla County:	
Sept. 6–11—	
Walla Walla	2
Yakima County:	
Aug. 13–Oct. 11—	
Donald	4
Grandview	1
North Yakima	28
Parker	11
Toppenish	100
Wapato	53
Wash., State total	224

WEST VIRGINIA.

Mason County:	
Aug.–Sept. 29—	
Letart	1
Point Pleasant	26
Wood County:	
July 11—	
Parkersburg	1
W. Va., State total	28

WISCONSIN.

Eau Claire County:	
July 22–Sept. 10—	
Eau Claire	2
Rock County:	
Sept.—	
Janesville	2
Winnebago County:	
July 21–Sept. 2—	
Oshkosh	5
Wis., State total	9

SOLANACEOUS CROPS.

Table 45.—EGGPLANT.

FLORIDA.

	Cars.
Alachua County:	
May–June—	
Rocky Point	6
Duval County:	
May 4–Dec. 9—	
Jacksonville	4
Hillsborough County:	
May 10–June 25—	
Tampa	30
Manatee County:	
May 20–July 1—	
Terra Ceia	46
Marion County:	
May–June—	
Orange Lake	2
Polk County:	
June 6–July 20—	
Bartow	22
Fla., State total	110

ILLINOIS.

Union County:	
Apr. 24–25—	
Cobden	2
Ill., State total	2

LOUISIANA.

	Cars.
Orleans Parish:	
June 14—	
New Orleans	1
La., State total	1

MARYLAND.

Baltimore City:	
Sept. 28—	
Baltimore	1
Md., State total	1

NEW JERSEY.

Gloucester County:	
Aug. 18–Oct. 4—	
Swedesboro	6
Salem County:	
Aug. 2–Oct. 7—	
Pedricktown	40
Penns Grove	8
N. J., State total	54

NEW YORK.

	Cars.
New York County:	
Oct. 3—	
New York	1
N. Y., State total	1

PENNSYLVANIA.

Philadelphia County:	
Aug.—	
Philadelphia	3
Pa., State total	3

VIRGINIA.

Norfolk County:	
June 30–Sept. 27—	
Norfolk	120
Portsmouth	1
Va., State total	121

SOLANACEOUS CROPS—Continued.

Table 46.—PEPPERS.

CALIFORNIA.

	Cars.
Los Angeles County:	
Oct. 21—	
Los Angeles	1
Sacramento County:	
Aug. 3–Sept. 18—	
Sacramento	5
San Francisco County:	
Mar. 17—	
San Francisco	1
San Joaquin County:	
Sept. 21–Oct. 26—	
Stockton	9
Cal., State total	16

FLORIDA.

Alachua County:	
May 20–July 29—	
Clyatt	8
Cyril	1
Evinston	5
Rocky Point	39
Duval County:	
Apr. 30–Dec. 14—	
Jacksonville	3
Hillsborough County:	
June 28—	
Plant City	1
Lee County:	
May 18–Dec. 30—	
Fort Meyers	25
Manatee County:	
May 10–June 3—	
Palmetto	7
Terra Ceia	5
Polk County:	
May 20–July 6—	
Bartow	23
St. Lucie County:	
Mar. 12–May 20—	
Fellsmere	4
Fla., State total	121

GEORGIA.

Spalding County:	
Nov. 11–16—	
Pomona	2
Ga., State total	2

LOUISIANA.

	Cars.
East Baton Rouge Parish:	
July 15–27—	
Baton Rouge	4
Orleans Parish:	
July 8—	
New Orleans	1
La., State total	5

MARYLAND.

Baltimore City:	
Sept. 23—	
Baltimore	1
Md., State total	1

MISSISSIPPI.

Copiah County:	
June 10–27—	
Crystal Springs	1
Pike County:	
June 24—	
Osyka	1
Miss., State total	2

MISSOURI.

Mississippi County:	
July—	
Bertrand	2
Mo., State total	2

NEW JERSEY.

Atlantic County:	
July 18–Sept. 23—	
Landisville	150
Cumberland County:	
June 13–Nov. 8—	
Bridgeton	41
Cedarville	81
Fairton	56
Greenwich	55
Husted	7
Mauricetown	3
Newport	21
Rosenhayn	21
South Vineland	17
Vineland	2
Woodruff's	5
Gloucester County:	
July 18–Nov. 16—	
Forest Grove	4
Malaga	2
Mickleton	2

NEW JERSEY—Continued.

	Cars.
Gloucester County—Contd.	
July 18–Nov. 16—	
Newfield	214
Richwood	17
Swedesboro	70
Monmouth County:	
Sept. 6–Oct. 14—	
Matawan	20
Salem County:	
July 17–Nov. 11—	
Elmer	8
Norma	43
Pedricktown	28
Penns Grove	16
Union County:	
Sept. 19–Oct. 11—	
Berkeley Heights	10
N. J., State total	893

NORTH CAROLINA.

Duplin County:	
July 26–Aug. 3—	
Faison	6
Pender County:	
July 26–Aug. 3—	
Rocky Point	6
N. C., State total	12

PENNSYLVANIA.

Philadelphia County:	
Oct.—	
Philadelphia	5
Pa., State total	5

SOUTH CAROLINA.

Marion County:	
Sept. 22—	
Mullins	1
S. C., State total	1

TENNESSEE.

Gibson County:	
July 19—	
Gibson	1
Tenn., State total	1

VIRGINIA.

Norfolk County:	
June 30–Nov. 1—	
Norfolk	5
Va., State total	5

Table 47.—TOMATOES.

ARKANSAS.

	Cars.
Carroll County:	
July—	
Green Forest	4
Ark., State total	4

CALIFORNIA.

Alameda County:	
Nov. 11–17—	
Hayward	2
Imperial County:	
May 16–Sept. 19—	
Brawley	87
Calexico	2
El Centro	1
Heber	9
Imperial	3

CALIFORNIA—Continued.

	Cars.
Los Angeles County:	
Jan. 7–Dec. 13—	
Central Avenue	1
El Monte	20
Gardena	133
Glendora	1
Los Angeles	267
Los Nietos	26
Newmark	18
Norwalk	1
Pico	20
Redondo Beach	11
Rosemead	1
Rowland	2
San Fernando	8
San Gabriel	17
San Pedro	69
Torrance	2
Tropico	4

CALIFORNIA—Continued.

	Cars.
Los Angeles County—Con.	
Jan. 7–Dec. 13—	
Vernondale	2
Watts	3
Wilmington	9
Wilmington Road	19
Merced County:	
June 17–July 19—	
Merced	24
Orange County:	
Sept. 6–Nov. 10—	
Buena Park	10
Fullerton	111
Garden Grove	30
Northam	25
Villa Park	1
West Anaheim	1
Yorba Linda	1

SOLANACEOUS CROPS—Continued.

Table 47.—TOMATOES—Continued.

CALIFORNIA—Continued.

	Cars.
Riverside County:	
June 4–24—	
Coachella	16
Mecca	5
Thermal	1
Sacramento County:	
July 7–Nov. 18—	
Sacramento	85
San Diego County:	
Sept. 27–Nov. 24—	
Escondida	32
San Francisco County:	
Oct. 14–Dec. 21—	
San Francisco	4
San Joaquin County:	
June 15–Oct. 9—	
Lodi	5
Manteca	4
Santa Clara County:	
Aug. 11–Nov. 13—	
Alviso	1
Mayfield	2
Morgan Hill	1
Mountain View	27
Palo Alto	2
Tulare County:	
June 8–Dec. 31—	
Sultana	11
Yuba County:	
July 11–Aug. 15—	
Marysville	32
Cal., State total	1,169

COLORADO.

Denver County:	
Apr. 1–Oct. 28—	
Denver	3
Mesa County:	
Sept.–Oct.—	
Grand Junction	42
Palisade	7
Colo., State total	52

DELAWARE.

Kent County:	
Aug. 14–Oct. 25—	
Brenford	30
Clayton	5
Harrington	37
Hartley	185
Houston	10
Viola	144
Woodside	120
New Castle County:	
Oct. 3–20—	
Blackbird	12
Townsend	63
Sussex County:	
Aug. 7–Oct. 30—	
Bridgeville	92
Broadhill	17
Cannon	89
Ellendale	2
Laurel	8
Lincoln City	150
Milford	70
Milton	19
Nassau	99
Seaford	87
Stockley	1
Del., State total	1,240

FLORIDA.

Alachua County:	
May 26–June 28—	
Clyatt	2
Evinston	5

FLORIDA—Continued.

	Cars.
Brevard County:	
Mar.–June—	
Fau Gallie	2
Hopkins	11
Melbourne	1
Titusville	1
Broward County:	
Mar.–June—	
Dania	314
Deerfield	212
Fort Lauderdale	432
Hallandale	362
Pompano	608
Dade County:	
Mar.–June—	
Arch Creek	109
Cocoanut Grove	65
Florida City	134
Fulford	58
Goulds	458
Homestead	394
Larkin	808
Little River	29
Miami	95
Perrine	625
Princeton	205
Duval County:	
May–Dec.—	
Jacksonville	22
South Jacksonville	5
Hillsborough County:	
May 1–June 30—	
Plant City	102
Tampa	102
Lee County:	
Nov. 26–Dec. 21	
Fort Meyers	3
Manatee County:	
Apr. 26–June 25—	
Ellenton	43
Oneco	25
Palmetto	63
Parish	29
Terra Ceia	48
Marion County:	
May 18–July 25—	
Anthony	8
Ocala	8
Reddick	4
Santos	5
South Side	1
Sparr	2
Monroe County:	
Apr.–May—	
Central Supply	3
Jewfish	24
Orange County:	
June 7–28—	
Orlando	9
Palm Beach County:	
Mar.–June—	
Boynton	115
Delray	329
Jupiter	17
Lake Worth	22
Stuart	4
West Palm Beach	4
Polk County:	
May 18–June 15—	
Bartow	18
St. Lucie County:	
Mar.–June—	
Fellsmere	2
Fort Pierce	8
Okeechobee	4
Sebastian	39
Vero	32
Seminole County:	
May 1–June 30—	
Sanford	30

FLORIDA—Continued.

	Cars.
Sumter County:	
May–June 15—	
Bushnell	20
Coleman	69
Panasoffkee	3
Sumterville	10
Webster	18
Wildwood	4
Fla., State total	6,184

GEORGIA.

Thomas County:	
June–July—	
Thomasville	2
Tift County:	
June 23–July 14—	
Tifton	3
Ga., State total	5

IDAHO.

Twin Falls County:	
Nov. 6—	
Buhl	1
Idaho, State total	1

ILLINOIS.

Adams County:	
Aug. 8–24—	
Quincy	6
Cook County:	
June 17–Dec. 11—	
Chicago	19
Dunning	1
Effingham County:	
Aug.–Oct.—	
Mason	2
Moccasin	10
Watson	20
Jackson County:	
Aug.–Oct.—	
Makanda	29
Kankakee County:	
Aug. 30–Oct. 30—	
Momence	6
Madison County:	
Sept. 12–Oct. 27—	
St. Jacob	5
Pulaski County:	
July 11–Aug. 26—	
Grand Chain	6
Villa Ridge	2
Union County:	
July 1–Aug. 30—	
Alto Pass	19
Anna	14
Cobden	98
Dongola	65
Wabash County:	
Aug. 21–Nov. 12—	
Bellmont	26
Mount Carmel	8
Ill., State total	336

INDIANA.

Bartholomew County:	
Aug. 31–Oct. 18—	
Columbus	11
Benton County:	
Nov.—	
Sheff	1
Clark County:	
Aug. 15–Oct. 20—	
Borden	115
Clinton County:	
Sept. 1–Oct. 5—	
Michigantown	35

SOLANACEOUS CROPS—Continued.

Table 47.—TOMATOES—Continued.

INDIANA—Continued.

	Cars.
Dekalb County:	
Aug. 29–Sept. 19—	
Butler	7
Delaware County:	
Aug. 23–Sept. 29—	
Anthony	24
Gibson County:	
Aug. 11–Oct. 24—	
Johnson	21
Oakland City	26
Grant County:	
July–Oct. 31—	
Fairmount	87
Marion	10
Matthews	22
Vanburen	15
Hancock County:	
Aug. 25–Oct.	
Charlottesville	23
Shirley	15
Wilkinson	47
Hendricks County:	
Aug. 18–Oct. 14—	
Amo	29
Plainfield	45
Jefferson County:	
Aug. 16–Oct. 20—	
Dupont	36
Madison	1
Middle Fork	70
Jennings County:	
Sept. 4–Oct. 18—	
Butlerville	20
Johnson County:	
Sept. 1–Oct. 13:	
Bargersville	19
Madison County:	
Aug.–Sept.—	
Orestes	37
Summitville	42
Marion County:	
Aug. 18–Oct. 16—	
Camby	56
Indianapolis	42
Montgomery County—	
Aug. 19–Oct. 31—	
Crawfordsville	15
Darlington	17
Morgan County:	
Aug. 17–Oct. 23—	
Brooklyn	17
Martinsville	25
Mooresville	2
Paragon	18
Owen County:	
Aug. 18–Oct. 15—	
Freedom	24
Pike County:	
Aug. 11–Nov. 1—	
Winslow	26
Putnam County:	
Aug. 23–Oct. 6—	
Fillmore	15
Limedale	1
Randolph County:	
Sept. 16—	
Ridgeville	2
Tipton County:	
Aug. 28–Oct.	
Kempton	12
Vermilion County:	
Aug. 1–Oct. 31—	
Cayuga	11
Vigo County:	
July 24–Oct. 14—	
Pimento	59
Riley	16
Seelyville	4
Terre Haute	36
Ind., State total	1,156

IOWA.

	Cars.
Des Moines County:	
Aug. 3—	
Burlington	1
Lee County:	
Oct. 1–Nov. 10—	
Montrose	3
Scott County:	
June 14–Aug. 2—	
Davenport	2
Iowa, State total	6

KANSAS.

Leavenworth County:	
July 18–Aug. 9—	
Leavenworth	15
Shawnee County:	
Aug. 9—	
Topeka	1
Kans., State total	16

KENTUCKY.

Carlisle County:	
Aug. 10–Oct. 26—	
Berkeley	38
Hickman County:	
Aug. 8–Oct. 21—	
Oakton	23
Jefferson County:	
July 22–Aug. 17—	
Louisville	19
Ky., State total	80

LOUISIANA.

East Feliciana Parish:	
June 3–28—	
Norwood	37
Orleans Parish:	
June–Dec.—	
New Orleans	21
La., State total	58

MARYLAND.

Baltimore City:	
Feb. 26–Aug. 30—	
Baltimore	196
Caroline County:	
Oct. 5–26—	
Tuckahoe	29
Carroll County:	
Oct. 30—	
Asbestos	1
Dorchester County:	
Aug. 10–Sept. 28—	
Linkwood	121
Harford County:	
Jan. 17–Dec. 21—	
Joppa	15
Rocks	47
Somerset County:	
July 1–Sept. 15—	
Eden	1
Kings Creek	49
Loretto	10
Princess Anne	21
Westover	20
July–Oct.:	
Chester River landings	18
July–Oct.:	
Choptank River landings	3
Aug. 3–Oct. 3:	
Nanticoke River landings	2
Aug. 4–Oct. 27:	
Patuxent River landings	12

MARYLAND—Continued.

	Cars.
June–Nov.:	
Potomac River landings	91
July 31–Oct. 2:	
Wicomico River landings	8
Md., State total	644

MASSACHUSETTS.

Essex County:	
Aug. 1—	
Lawrence	1
Suffolk County:	
Aug. 1—	
Boston	3
Mass., State total	4

MICHIGAN.

Bay County:	
Sept.–Oct.—	
Bay City	44
Kent County:	
July 14–Sept.—	
Dutton	3
Grand Rapids	3
Mason County:	
Aug. 31–Oct. 13—	
Ludington	10
Monroe County:	
Oct.—	
Federman	18
Ida	1
Muskegon County:	
July 14—	
Muskegon	7
Ottawa County—	
Aug. 11–25—	
Grand Haven	2
Mich., State total	88

MINNESOTA.

Hennepin County:	
Aug.—	
Minneapolis	4
Minn., State total	4

MISSISSIPPI.

Copiah County:	
May 29–July 15—	
Crystal Springs	771
Gallman	182
Gatesville	22
Georgetown	12
Hazlehurst	402
Hopewell	77
Martinsville	13
Rockport	18
Wesson	9
Hinds County:	
June 2–24—	
Terry	90
Jefferson County:	
May 26–June 21—	
Fayette	13
Lincoln County:	
June 3–29—	
Brookhaven	9
Walthall County:	
June 1–27—	
Tylertown	27
Wilkinson County:	
May 31–June 20—	
Centerville	18
Miss., State total	1,663

SOLANACEOUS CROPS—Continued.

Table 47.—TOMATOES—Continued.

	Cars.
MISSOURI.	
Laclede County:	
Oct. 1–Nov. 30—	
Conway	13
Lawrence County:	
Nov. 1—	
Miller	1
St. Louis City:	
June 9–Aug. 24—	
St. Louis	27
Mo., State total	41
NEW JERSEY.	
Burlington County:	
Aug. 16–Oct. 20—	
Columbus	51
Mount Holly	28
Pemberton	104
Smithville	159
Cape May County:	
Aug.–Sept.—	
Goshen	12
Cumberland County:	
Aug. 2–Nov. 10—	
Bridgeton	76
Cedarville	2
Fairton	1
Greenwich	116
Mauricetown	3
Newport	80
Port Norris	15
Rosenhayn	1
South Vineland	2
Vineland	1
Gloucester County:	
June 30–Sept. 30—	
Clarksboro	46
Harrisonville	1
Mickleton	97
Mullica Hill	50
Richwood	91
Swedesboro	1,159
Williamstown	15
Woodbury	137
Hunterdon County:	
Aug. 15–Nov. 15—	
Flemington	15
Mercer County:	
Aug. 17–Oct. 14—	
Robbinsville	71
Yardsville	1
Middlesex County:	
Aug. 9—	
Lower Jamesburg	1
Monmouth County:	
July 21–Oct. 23—	
Cliffwood	4
Cream Ridge	39
Eatonton	14
Freehold	27
Keansburg	105
Matawan	125
Morganville	1
Red Bank	21
Ocean County:	
Aug. 30–Oct. 14—	
New Egypt	53
Salem County:	
July 8–Oct. 16—	
Alloway Junction	7
Norma	8
Palatine	90
Pedricktown	95
Penns Grove	44
Woodstown	154
N. J., State total	3,122
NEW MEXICO.	
Eddy County:	
Oct.—	
Dayton	2
N. Mex., State total	2
NEW YORK.	
Cattaraugus County:	
Sept. 6–Oct. 12—	
Perrysburg	6
Chautauqua County:	
Aug. 28–Nov.—	
Brocton	4
Forestville	5
Irving	1
Laona	1
Ripley	14
Sheridan	1
Silver Creek	5
Smith's Mills	11
Erie County:	
July 1–Nov. 11—	
Angola	36
Buffalo	2
Farnham	17
North Collins	18
Monroe County:	
Aug.–Oct.—	
Barnard	1
Rochester	8
Nassau County:	
Sept. 23–Oct. 17—	
Syosset	10
Niagara County:	
Sept.–Nov.—	
Burt	10
Gasport	20
Lockport	12
Middleport	2
Ransomville	7
Wilson	11
Orleans County:	
Sept.–Oct.—	
Carlton	8
Fancher	31
Lyndonville	2
Suffolk County:	
Sept. 6–Oct. 26—	
Laurel	17
Ulster County:	
Oct.—	
Esopus	2
N. Y., State total	262
OHIO.	
Ashtabula County:	
Sept.–Oct.—	
Ashtabula	5
Geneva	1
Butler County:	
Aug. 15–Sept. 22—	
West Middletown	9
Clermont County:	
Aug.—	
Amelia	4
Cuyahoga County:	
July 31–Aug. 2—	
Cleveland	4
Defiance County:	
Sept. 1–Oct. 11—	
Hicksville	16
Erie County:	
Oct. 5–12—	
Sandusky	1
Franklin County:	
July—	
Columbus	1
Fulton County:	
July–Aug.—	
Metamora	32
OHIO—Continued.	
Hamilton County:	
May–Aug.—	
Cincinnati	15
Harrison	24
Lake County:	
Sept.–Oct.—	
Madison	6
Lucas County:	
July 31–Sept. 11—	
Olive Street Junction	1
Toledo	13
Meigs County:	
July—	
Rutland	2
Ottawa County:	
Sept. 2–Nov.—	
La Carne	1
Oak Harbor	18
Williston	10
Seneca County:	
Aug. 28–Oct. 18—	
Fostoria	73
Washington County:	
July 17–Oct. 18—	
Lowell	114
Marietta	13
Waterford	34
Wood County:	
Aug. 15–Oct. 31—	
Bloomdale	43
Bowling Green	1
Dunbridge	56
Pemberville	4
Weston	89
Ohio, State total	590
OREGON.	
Multnomah County:	
Oct. 14–Nov. 7—	
East Portland	1
Portland	1
Umatilla County:	
Aug. 17—	
Freewater	1
Oreg., State total	3
PENNSYLVANIA.	
Beaver County:	
Aug.—	
Geneva	2
Erie County:	
Sept. 25—	
North East	2
Lackawanna County:	
Aug.–Sept.—	
Scranton	9
Montgomery County:	
Aug. 2–Oct. 25—	
Norristown	19
Philadelphia County:	
July 19–Oct. 31—	
Philadelphia	303
Shackamaxon	16
Westmoreland County:	
Aug.—	
Madison	2
York County:	
July 15–Nov. 30—	
Red Lion	7
Pa., State total	360

SOLANACEOUS CROPS—Continued.

Table 47.—TOMATOES—Continued.

SOUTH CAROLINA.

	Cars.
Beaufort County:	
June 20–Aug. 1—	
Beaufort	2
Port Royal	3
Charleston County:	
May 8–June 8—	
Charleston	3
Jasper County:	
July 10–31—	
Ridgeland	2
S. C., State total	10

TENNESSEE.

Crockett County:	
June 15–July 25—	
Gadsden	35
Davidson County:	
July 28—	
Nashville	1
Gibson County:	
June 20–July 29—	
Bradford	12
Fruitland	60
Gibson	198
Humboldt	130
Medina	20
Milan	156
Lauderdale County:	
July 1–Aug. 2—	
Gates	8
Halls	112
Ripley	3
Madison County:	
July 10–18—	
Jackson	7
Maury County:	
Aug. 21–Oct. 3—	
Rankin	5
Sumner County:	
July 1–25—	
Hendersonville	25
Weakley County:	
June—	
Martin	24
Tenn., State total	796

TEXAS.

Anderson County:	
June 10–July 14—	
Elkhart	6
Frankston	46

TEXAS—Continued.

	Cars.
Cameron County:	
May 24–June 6—	
Brownsville	2
Rio Hondo	3
San Benito	7
Chambers County:	
June 1–July 15—	
Stowell	7
Cherokee County:	
June 1–July 9—	
Alto	218
Craft	64
Dialville	88
Gallatin	74
Jacksonville	297
Maydelle	24
Mt. Selman	39
Ponta	12
Rusk	28
Dallas County:	
June 1–Aug.—	
Dallas	9
Dimmit County:	
May 10—	
Carrizo Springs	4
Mongtomery County:	
May 24–June 21—	
Willis	29
Nacogdoches County:	
June 15–29—	
Nacogdoches	3
Sacul	9
San Patricio County:	
May 22–June 7—	
Arkansas Pass	11
Smith County:	
June–July—	
Flint	67
Tyler	77
White House	17
Tarrant County:	
July 22–Sept. 29—	
Fort Worth	6
Walker County:	
June 5–18—	
Dodge	6
Tex., State total	1,153

UTAH.

Boxelder County:	
Sept. 28–Oct. 16—	
Brigham	4
Utah County:	
Sept. 26–Oct. 2—	
Provo	3

UTAH—Continued.

	Cars.
Weber County:	
Aug. 30–Dec. 5—	
Ogden	46
Roy	11
West Weber	3
Utah, State total	67

VIRGINIA.

Campbell County:	
Nov. 2–20—	
Leesville	3
Elizabeth City County:	
June 20–July 27—	
Old Point Comfort	22
Norfolk County:	
July 3–Aug. 19—	
Norfolk	45
Portsmouth	1
Roanoke County:	
Sept. 15–Oct. 6—	
Starkey	4
York County:	
July 26–Aug. 30—	
Yorktown	25
Aug. 1–Oct. 3;	
Piankatank River landings	1
June–Nov.:	
Potomac River landings	90
June–Sept. 7:	
Rappahannock River landings	1
Va., State total	192

WASHINGTON.

Yakima County:	
Aug. 4–Sept. 1—	
North Yakima	7
Wapato	1
Wash., State total	8

WEST VIRGINIA.

Morgan County:	
Sept. 30–Oct. 30—	
Hancock	7
W. Va., State total	7

TUBER CROPS.

Table 48.—WHITE POTATOES.

ALABAMA.

	Cars.
Baldwin County:	
Apr. 19–Sept. 5—	
Bay Minette	5
Foley	39
Loxley	3
Silverhill	5
Covington County:	
May 2–Dec. 31—	
Andalusia	4
Cullman County:	
Aug. 12–Sept. 25—	
Cullman	6
Hale County:	
June 14—	
Akron	1

ALABAMA—Continued.

	Cars.
Mobile County:	
Apr.–Dec. 31—	
Dawes	18
Grand Bay	5
Irvington	2
Mobile	63
St. Elmo	6
Semmes	1
Tacon	14
Theodore	27
Sumter County:	
May 10–Sept. 15—	
York	16
Ala., State total	215

ARIZONA.

	Cars.
Coconino County:	
June–Apr.—	
Flagstaff	27
Maricopa County:	
June–Apr.—	
Glendale	30
Ariz., State total	57

ARKANSAS.

Ashley County:	
May 25–July 1—	
Portland	3
Chicot County:	
June 10—	
Eudora	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

ARKANSAS—Continued.

	Cars.
Clark County:	
June 10–July 10—	
Arkadelphia	2
Columbia County:	
July 10—	
Magnolia	1
Crawford County:	
June 6–30—	
Alma	30
Dyer	6
Franklin County:	
June 15–July 7—	
Branch	6
Charleston	23
White Oak	2
Jackson County:	
July—	
Newport	2
Jefferson County:	
June 10–Dec. 20—	
Rob Roy	18
Johnson County:	
June 28—	
Hartman	1
Lincoln County:	
June 10–Dec. 20—	
Varner	6
Logan County:	
June 6–July 7—	
Booneville	25
Paris	2
Lonoke County:	
June–Apr.—	
Lonoke	12
Miller County:	
June 1—	
Texarkana	1
Mississippi County:	
June 8–22—	
Osceola	4
Wilson	3
Pulaski County:	
June 26—	
Alexander	1
St. Francis County:	
June–Apr.—	
Forest City	2
Sebastian County:	
May 31–Mar. 31—	
Barling	12
Bonanza	17
Fort Smith	313
Greenwood	13
Hackett	4
Huntington	2
Lavaca	12
Ursula	10
Union County:	
May 25–July 1—	
El Dorado	3
Ark., State total	537

CALIFORNIA.

	Cars.
Alameda County:	
June–Mar.—	
Alameda	1
Oakland	16
Contra Costa County:	
July–Jan.—	
Antioch	12
Orwood	123
Eldorado County:	
Nov. 20–Feb. 22—	
Camino	2
Fresno County:	
May 13–Dec. 8—	
Burkhead	1
Fresno	2
Laton	1
Minkler	32
Sanger	2

CALIFORNIA—Continued.

	Cars.
Imperial County:	
Feb. 23–May 19—	
Brawley	1
El Centro	1
Kern County:	
June 6–July 24—	
Bakersfield	8
Shafter	16
Strader	1
Lassen County:	
Oct. 24–Nov. 23—	
Omira	3
Wendel	1
Los Angeles County:	
Apr.–Jan.—	
Arcadia	126
Baldwin Park	66
Bassett	7
Central Avenue	1
Claremont	1
Compton	21
Downey	10
El Monte	80
El Segundo	1
Florence	122
Gardena	1
Hobart	3
Irwindale	30
Kester Junction	1
Los Angeles	146
Marion	25
Monrovia	19
Norwalk	1
Owensmouth	17
Pasadena	1
Pico	4
Pomona	1
Puente	36
Rivera	16
Rowland	1
San Gabriel	14
San Pedro	68
Saugus	2
Sylmar	21
Torrance	5
Tropico	4
Van Nuys	59
Watts	26
Madera County:	
Jan. 13–Apr. 3—	
Chowchilla	10
Modoc County:	
Oct. 31–Dec. 31—	
Alturas	1
Davis Creek	4
Monterey County:	
Aug. 5–Dec. 30—	
Blanco	13
Chualar	1
Salinas	8
Spreckels	1
Orange County:	
Apr.–Jan.—	
Anaheim	25
Buena Park	28
Fullerton	7
Garden Grove	23
La Habra	2
Placentia	6
Richfield	1
San Juan Capistrano	1
Santa Ana	2
Stanton Junction	1
West Anaheim	23
Winterburg	3
Placer County:	
Nov. 11—	
Penryn	1
Riverside County:	
May 29–Nov. 15—	
Beaumont	1
Perris	28
Temecula	7

CALIFORNIA—Continued.

	Cars.
Sacramento County:	
June–May—	
Elvas	9
Sacramento	162
San Bernardino County:	
June 12–Dec. 18—	
Alta Loma	1
Colton	1
Cucamonga	15
Del Rosa	3
Loma Linda	2
San Bernardino	2
San Francisco County:	
June–May—	
San Francisco	1,008
San Joaquin County:	
June–May—	
Holt	439
Middle River	490
Stockton	3,841
Woodsbro	52
San Mateo County:	
Apr. 26–June 15—	
Colma	47
Santa Barbara County:	
Feb. 14–Nov. 6—	
Guadalupe	1
Lompoc	1
Santa Barbara	1
Santa Clara County:	
July 25–Dec. 9—	
Quito	7
Santa Cruz County:	
July–Apr.—	
Aptos	1
Watsonville	113
Shasta County:	
Oct. 28—	
Anderson	1
Siskiyou County:	
Nov. 10—	
Hornbrook	1
Sonoma County:	
Nov. 4–Dec. 13—	
Sebastapol	9
Stanislaus County:	
Aug. 16—	
Turlock	1
Sutter County:	
June 22–Dec. 16—	
Tarke	1
Tudor	1
Yuba City	27
Tulare County:	
June 22–Aug. 1—	
Cutler	1
Visalia	1
Yolo County:	
July—	
Kiesel	1
Yuba County:	
June–Apr.—	
Marysville	5
Rio Oso	4
Cal., State total	7,605

COLORADO.

	Cars.
Adams County:	
Oct. 2–Nov. 18—	
Brighton	2
Hazeltine	5
Alamosa County:	
Aug. 25–Nov. 3—	
Alamosa	9
Hooper	22
Archuleta County:	
Oct. 12–Dec. 16—	
Pagosa Springs	6
Cheyenne County:	
Oct. 21–Feb. 16—	
Kit Carson	2

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

COLORADO—Continued.

	Cars.
Conejos County:	
Aug.-May—	
Antonito	23
Romeo	28
Delta County:	
Sept. 1-Jan. 1—	
Austin	45
Delta	424
Paonia	4
Denver County:	
July 14-June 19—	
Denver	33
Eagle County:	
Aug. 31-May 18—	
Avon	65
Basalt	141
Eagle	334
Easum	9
Gypsum	94
McCoy	1
State Bridge	1
Wolcott	4
Elbert County:	
Oct. 27-Nov. 15—	
Elbert	3
Garfield County:	
Sept. 15-Feb. 10—	
Carbondale	879
Cardiff	13
Glenwood Springs	16
Grand Valley	45
Newcastle	130
Rifle	114
Silt	82
Hinsdale County:	
May 5—	
Lake City	1
Jefferson County:	
Oct. 20-Nov. 20—	
Pine Grove	4
Kit Carson County:	
Nov. 1-18—	
Siebert	4
Lake County:	
Oct. 21-23—	
Evans	2
La Plata County:	
Oct. 1-Dec. 31—	
Durango	10
Larimer County:	
Oct.-Apr. 26—	
Fort Collins	30
Lincoln County:	
Nov. 24—	
Limon	2
Logan County:	
Dec.-May—	
Peetz	1
Sterling	5
Mesa County:	
Sept. 9-Apr.—	
De Beque	6
Fruita	45
Loma	1
Mack	2
Palisade	2
Moffat County:	
Dec.-Feb.—	
Craig	6
Montezuma County:	
Oct. 5-Dec. 3—	
Dolores	21
Mancos	3
Montrose County:	
Aug. 22-June 13—	
Cimarron	15
Montrose	679
Olathe	522
Morgan County:	
Sept. 18-Mar.—	
Brush	19
Fort Morgan	8
Goodrich	2

COLORADO—Continued.

	Cars.
Morgan County—Contd.	
Sept. 18-Mar.—	
Orchard	10
Snyder	2
Weldon	2
Ouray County:	
Oct. 15-Nov. 25—	
Ridgway	11
Phillips County:	
May 12-13—	
Holyoke	2
Pitkin County:	
Oct.-May—	
Aspen	9
Pueblo County:	
July-Dec.—	
Pueblo	4
Rio Grande County:	
Aug. 25-Jan. 9—	
Del Norte	288
Monte Vista	1,723
Routt County:	
Oct.-Feb.—	
Deer Park	1
Hayden	10
Milner	2
Oak Creek	3
Sidney	22
Steamboat Springs	3
Trapper	1
Saguache County:	
Aug. 22-Nov. 13—	
Center	118
Mineral Hot Springs	1
Sedgwick County:	
Sept.-Feb.—	
Julesburg	40
Ovid	10
Sedgwick	2
Teller County:	
Oct. 27-Nov. 2—	
Divide	2
Woodland Park	2
Weld County:	
Aug. 31-June 20—	
Ault	741
Cloverly	200
Crest	3
Eaton	1,267
Galeton	206
Gilcrest	14
Gill	116
Gowanda	3
Greeley	708
Grover	26
Hardin	6
Hungerford	1
Johnstown	2
Keota	1
Kersey	183
La Salle	58
Lucerne	374
Lupton	1
Masters	1
Mead	1
Pierce	149
Severance	314
Windsor	18
Additional shipments in box cars	442
Yuma County:	
Nov. 2—	
Laird	1
Colo., State total	11,028

CONNECTICUT.

	Cars.
Hartford County:	
Oct. 11-Nov. 19—	
East Windsor	1
Suffield	1

CONNECTICUT—Continued.

	Cars.
Litchfield County:	
Aug. 24-May 13—	
New Preston	2
Pine Meadow	1
Tolland County:	
Oct. 11-29—	
Ellington	4
Conn., State total	9

DELAWARE.

	Cars.
Kent County:	
Aug. 10-Nov.—	
Hartly	1
Wyoming	13
New Castle County:	
July-Apr.—	
Middletown	5
Townsend	1
Sussex County:	
July 1-Mar. 8—	
Bridgeville	6
Cannon	2
Dagsboro	7
Delmar	4
Frankford	10
Georgetown	10
Laurel	7
Lincoln City	5
Milford	1
Millsboro	1
Milton	7
Nassau	18
Oak Grove	2
Overbrook	1
Seaford	6
Selbyville	11
Stockley	3
Del., State total	121

FLORIDA.

	Cars.
Alachua County:	
Apr.-May—	
Evinston	1
Wannee	7
Bradford County:	
May 19-31—	
Graham	10
Raiford	35
Starke	4
Clay County:	
May 9-17—	
Orange Park	3
De Soto County:	
May 6-20—	
Fort Green Springs	1
Wauchula	1
Duval County:	
Apr.-Nov. 18—	
Florida Transfer	38
Jacksonville	8
South Jacksonville	1
Hillsborough County:	
Apr.-May—	
Knights	3
Plant City	57
Seffner	1
Ybor City	3
Lake County:	
Apr.—	
Astor	1
Levy County:	
May 13-23—	
Williston	2
Marion County:	
May 29-Nov. 2—	
Anthony	5
Oklawaha	33

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

FLORIDA—Continued.

	Cars.
Orange County:	
May 20–25—	
Oakland	4
Orlando	11
Polk County:	
May 18–June 3—	
Bartow	8
Chicora	1
Lakeland	6
Putnam County:	
Apr.–June 1—	
Bostwick	11
Crescent City	10
East Palatka	153
Federal Point	132
Orange Mills	53
Palatka	3
San Mateo	4
St. Johns County:	
Apr.–May—	
Armstrong	37
Bayard	1
Bunnell	24
Dupont	54
East Tocoi	50
Elkton	347
Espanola	9
Hastings	757
Riverdale	1
Roy	3
St. Augustine	11
St. Johns Park	1
Spuds	42
Yelvington	50
Seminole County:	
Apr.–May 31—	
Sanford	7
Fla., State total	2,004

GEORGIA.

Bryan County:	
Apr.—	
Ways Station	2
Chatham County:	
Mar.–Feb.—	
Savannah	83
Grady County:	
Apr.–May—	
Cairo	23
Calvary	1
Thomas County:	
Apr.—	
Thomasville	3
Tift County:	
Mar. 14—	
Tifton	1
Wayne County:	
Mar. 14—	
Nahunta	1
Ga., State total	114

IDAHO.

Ada County:	
Feb. 19—	
Boise	2
Meridian	1
Adams County:	
Nov. 20–31—	
Council	2
Bannock County:	
Oct. 21–Mar. 16—	
Downey	19
Oxford	1
Pocatello	13
Bear Lake County:	
Oct. 18–May 25—	
Montpelier	2

IDAHO—Continued.

	Cars.
Bingham County:	
Sept. 11–June 16—	
Aberdeen	9
Blackfoot	653
Firth	318
Fort Hall	1
Pingree	8
Shelley	944
Sterling	11
Virden	1
Blaine County:	
May 6–11—	
Moore	2
Bonneville County:	
Aug. 25–June 13—	
Glen	4
Idaho Falls	2,091
Iona	64
Lincoln	1
Ucon	299
Canyon County:	
Aug. –Apr. 9—	
Caldwell	227
Fruitland	6
Nampa	2
New Plymouth	2
Notus	4
Parma	2
Payette	10
Cassia County:	
Sept. 19–May 26—	
Burley	282
Marshfield	60
Franklin County:	
Oct. 6–25—	
Franklin	1
Garner	1
Preston	2
Weston	4
Fremont County:	
Oct.–Mar.—	
Ashton	2
St. Anthony	10
Gooding County:	
Nov.–June 8—	
Gooding	8
Wendell	21
Idaho County:	
Nov. 4–29	
Grangeville	2
Jefferson County:	
Sept. 19–May 31—	
Camas	2
Lorenzo	45
Menan	53
Rigby	189
Roberts	21
Kootenai County:	
Nov.–June—	
Coeur d'Alene	1
Paul	4
Post Falls	3
Latah County:	
Oct. 26–Dec. 14—	
Deary	3
Genesee	2
Kendrick	1
Kennedy Ford	2
Moscow	8
Potlatch	3
Princeton	1
Vassar	1
Wellesley	2
Lemhi County:	
Oct. 21—	
Salmon	1
Lewis County:	
Oct. 28—	
Nez Perce	1
Lincoln County:	
Nov.–Apr. 23—	
Dietrich	11
Jerome	32

IDAHO—Continued.

	Cars.
Madison County:	
Oct.–Apr.—	
Rexburg	4
Ririe	34
Thornton	23
Victor	1
Minidoka County:	
Oct.–Apr.—	
Eden	40
Hazelton	6
Heyburn	13
Minidoka	9
Ruppert	198
Nez Perce County:	
July 24–Nov. 24—	
Culdesac	3
Lewiston	4
Oneida County:	
Oct. 21–Nov. 7—	
Malad	3
Owyhee County:	
Nov.–Jan.—	
Homedale	10
Shoshone County:	
Mar. 14—	
Wallace	1
Twin Falls County:	
July 28–June 9—	
Buhl	46
Filer	261
Hansen	37
Kimberly	154
Murtaugh	44
Twin Falls	434
Washington County:	
Oct. 20–Nov. 6—	
Weiser	5
Idaho, State total	6,808

ILLINOIS.

Adams County:	
June 12–Dec. 18—	
Quincy	14
Alexander County:	
July–May—	
Cairo	12
Bureau County:	
Jan. 26–May 18—	
Kasbeer	2
Princeton	2
Cook County:	
July–June—	
Blue Island	585
Chicago	105
Franklin Park	3
Morton Grove	4
Norpaul	92
South Holland	5
Fayette County:	
Oct. 22—	
Vandalia	1
Fulton County:	
Oct.—	
Canton	1
Kankakee County:	
Oct. 28–Nov. 2—	
Wichert	2
Knox County:	
Nov.–Jan.—	
Galesburg	8
La Salle County:	
May 12—	
Mendota	1
Lee County:	
Oct. 16–May 6—	
Amboy	1
Scarboro	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

ILLINOIS—Continued.

	Cars.
Madison County:	
June 1–Sept. 4—	
Alton	2
Edwardsville	59
Fruit	2
Nameoki	87
Morgan County:	
Dec.–Jan.—	
Jacksonville	3
Ogle County:	
May 8–June 3—	
Hazelhurst	1
Kings	2
Peoria County:	
Sept. 24–Mar. 23—	
Peoria	12
Perry County:	
Dec. 16—	
DuQuoin	1
Pulaski County:	
May 3–July 1—	
Grand Chain	1
Red Bud	3
Putnam County:	
May 17—	
Putnam	1
St. Clair County:	
June 21–Dec. 31—	
Belleville	39
Broadway	3
East St. Louis	30
Freeburg	51
Mascoutah	17
Sangamon County:	
June 21—	
Williamsonville	1
Stark County:	
June 21–July 1—	
Castleton	2
Stephenson County:	
May 31—	
German Valley	1
Whiteside County:	
July–May—	
Fulton	52
Garden Plain	3
Sterling (Rock Falls)	1
Will County:	
Oct. 11–Apr. 25—	
Joliet	78
Winnebago County:	
June 8–July 20—	
Rockford	2
Ill., State total	1,293

INDIANA.

	Cars.
Allen County:	
Sept.–Jan.—	
Arcola	1
Fort Wayne	12
Grabill	1
Benton County:	
Sept.–Nov.—	
Wadena	2
Blackford County:	
Sept.—	
Hartford City	1
Carroll County:	
Mar. 24–Apr. 27—	
Camden	5
Flora	4
Cass County:	
Apr. 20–June 23—	
Logansport	2
Clark County:	
July 28–Aug. 24—	
Jeffersonville	5
Clinton County:	
Nov.—	
Rossville	1

INDIANA—Continued.

	Cars.
Dekalb County:	
Oct.–May—	
Auburn	42
Auburn Junction	1
Butler	3
St. Joe	9
Spencerville	2
Summit	1
Waterloo	7
Elkhart County:	
July–May—	
Bristol	8
Elkhart	4
Foraker	2
Goshen	1
Napance	1
Vistula	4
Wakarusa	8
Floyd County:	
Sept. 9–Nov. 22—	
New Albany	8
Fountain County:	
Apr.—	
Attica	1
Fulton County:	
Apr. 27–May 25—	
Kewanna	7
Grant County:	
Aug.–June—	
Gas City	1
Marion	1
Howard County:	
Dec.–Jan.—	
Kokomo	3
Jackson County:	
Oct.–Dec.—	
Seymour	2
Jefferson County:	
Apr.—	
Madison	2
Kosciusko County:	
May—	
Etna Green	2
Lake County:	
Dec.–Mar.—	
East Chicago	3
Hammond	2
Indiana Harbor	5
Laporte County:	
Nov.–May—	
Alida	5
Hanna	3
Haskell	15
La Crosse	4
Mill Creek	1
Stillwell	9
Union Center	3
Union Mills	4
Wanatah	3
Westville	17
Madison County:	
Dec.—	
Elwood	1
Marshall County:	
Oct.–May—	
Bourbon	3
Bremen	5
Culver	4
Plymouth	6
Teegarden	1
Tyner	2
Miami County:	
Oct.—	
Converse	1
Montgomery County:	
Apr.—	
Waynetown	1
Newton County:	
Dec.—	
Morocco	1

INDIANA—Continued.

	Cars.
Noble County:	
Dec.—	
Kendallville	4
La Otto	2
Porter County:	
Nov.–Apr.—	
Coburg	3
Valparaiso	7
Pulaski County:	
Apr.—	
Denham	1
Winamac	1
Randolph County:	
Sept.–Apr.—	
Ridgeville	3
St. Joseph County:	
Aug.–June—	
Crumstown	3
Lakeville	6
New Carlisle	6
South Bend	28
Walkerton	5
Wyatt	1
Starke County:	
Oct.–May—	
Hamlet	4
Knox	5
North Judson	2
Ober	1
San Pierre	1
Warren County:	
Mar.–May—	
West Lebanon	2
Williamsport	1
Wayne County:	
Sept.–June—	
Richmond	10
White County:	
Sept.–Dec. 9—	
Brookston	1
Idaville	1
Monticello	1
Whitley County:	
Jan. 5–May 22—	
Churubusco	2
Collins	2
Columbia City	9
Ind., State total	365

IOWA.

Allamakee County:	
Nov.—	
Waukon Junction	1
Benton County:	
Nov.—	
Belle Plaine	1
Blackhawk County:	
Oct.–Nov.—	
Waterloo	2
Boone County:	
Nov.–May—	
Boone	5
Madrid	1
Buchanan County:	
Mar. 11—	
Rowley	1
Buena Vista County:	
Oct.–Nov.—	
Alta	25
Marathon	2
Sioux Rapids	1
Butler County:	
May—	
Bristow	1
Dumont	1
Calhoun County:	
Apr.—	
Knoke	1
Lavinia	1
Rockwell City	2

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

IOWA—Continued.

	Cars.
Carroll County:	
Oct. 10–May 16—	
Arcadia	2
Carroll	4
Halbur	3
Manning	9
Cedar County:	
Apr. 28—	
Bennett	1
Cerro Gordo County:	
Oct. 31–Nov. 21—	
Clear Lake	1
Dougherty	1
Mason City	3
Ventura	1
Cherokee County:	
May 15—	
Aurelia	1
Chickasaw County:	
Oct.—	
Bassett	1
Ionia	1
New Hampton	1
Clay County:	
Nov.–May—	
Spencer	4
Clayton County:	
Dec.—	
McGregor	2
Clinton County:	
Dec.–May—	
Calamus	1
Clinton	9
Grand Mound	1
Lyons	1
Crawford County:	
Oct. 10–18—	
West Side	2
Dallas County:	
Dec.–May—	
Adel	2
De Soto	2
Linden	1
Perry	1
Redfield	1
Waukee	3
Delaware County:	
Oct.—	
Oneida	1
Des Moines County:	
Nov.—	
Burlington	1
Dickinson County:	
Apr.—	
Spirit Lake	1
Dubuque County:	
Dec.–June—	
Dubuque	15
Graf	2
Worthington	1
Emmet County:	
Oct.—	
Ringsted	1
Fayette County:	
Sept. 28—	
West Union	1
Floyd County:	
Oct.–Jan.—	
Charles City	8
Fremont County:	
Oct. 13–Nov. 1—	
Riverton	2
Sidney	1
Greene County:	
Sept. 26–Nov.—	
Churdan	1
Cooper	1
Grand Junction	1
Jefferson	2
Grundy County:	
Oct.–Mar.—	
Conrad	2
Grundy Center	26
Wellsburg	1

IOWA—Continued.

	Cars.
Hamilton County:	
Sept.–Apr.—	
Blairsburg	1
Stratford	1
Webster City	6
Harrison County:	
Aug. 25–Sept. 9—	
Orson	4
Howard County:	
Oct.–Mar.—	
Cresco	1
Elma	1
Lime Springs	2
Ida County:	
Oct.–Apr.—	
Galva	1
Holstein	2
Jackson County:	
Oct.–Dec.—	
Maquoketa	1
Zwingle	1
Jones County:	
Oct.–May—	
Center Junction	2
Martelle	1
Kossuth County:	
Oct.–Dec. 20—	
Algona	2
Luverne	7
Wesley	1
Whittemore	1
Linn County:	
Sept.–Dec.—	
Cedar Rapids	20
Lyon County:	
Apr. 8–28—	
Alvord	1
George	1
Mahaska County:	
Jan.—	
Lakonta	4
Marshall County:	
Oct.—	
Rhodes	1
Mitchell County:	
Oct.–June—	
Carpenter	8
Mitchell	5
Osage	6
Otranto	12
St. Ansgar	77
Toeterville	21
Monona County:	
Sept. 14–20—	
Blencoe	1
Whiting	2
Muscatine County:	
Nov.—	
Wilton	1
O'Brien County:	
Dec.–Apr.—	
Sheldon	7
Osceola County:	
Apr. 25–May 19—	
Melvin	2
Palo Alto County:	
Dec.–Apr.—	
Emmetsburg	2
Pocahontas County:	
Nov.—	
Fonda	1
Polk County:	
July–Sept.—	
Des Moines	11
Pottawattamie County:	
Aug.–Dec.—	
Council Bluffs	8
Sac County:	
Oct.—	
Early	1
Lytton	2

IOWA—Continued.

	Cars.
Scott County:	
Sept.–May—	
Davenport	9
Dixon	1
Donahue	1
Eldridge Junction	5
Walcott	5
Sioux County:	
Nov.–Apr.—	
Alton	2
Boyden	1
Hawarden	6
Hull	1
Ireton	3
Perkins	1
Rock Valley	2
Story County:	
Oct.–Apr.—	
Ames	4
Collins	1
Colo	1
Maxwell	1
Slater	3
Story City	1
Tama County:	
Oct.–Apr.—	
Chelsea	1
Garwin	2
Potter	1
Tama	2
Wapello County—	
Nov.–Feb.—	
Ottumwa	5
Wayne County:	
Oct.–Nov.—	
Sewal	1
Seymour	1
Webster County:	
Oct.—	
Gowrie	1
Lehigh	1
Winnebago County:	
Mar.—	
Lake Mills	1
Winneshiek County:	
Oct.—	
Ridgeway	1
Woodbury County:	
Aug.–June—	
Salix	1
Sergeant Bluff	35
Sioux Center	6
Sioux City	128
Sloan	2
Worth County:	
May—	
Hanlontown	3
Wright County:	
Oct.–Apr.—	
Eagle Grove	4
Iowa, State total	645

KANSAS.

Atchison County:	
Sept. 16–Nov. 3—	
Atchison	8
Cowley County:	
Aug. 4—	
Winfield	1
Douglas County:	
Aug. 4–Mar. 19—	
Eudora	131
Lawrence	77
Franklin County:	
Aug. 17–19—	
Ottawa	3
Jefferson County:	
Feb. 19–25—	
Grantville	14
Newman	6
Perry	72
Williamstown	50

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

KANSAS—Continued.

	Cars.
Johnson County:	
Aug. 28-July 6—	
De Soto	160
Olathe	1
Wilder	84
Zarah	1
Kearny County—	
July 22-Aug. 11—	
Kearney	3
Kingman County:	
Oct. 1-16—	
Cunningham	2
Leavenworth County:	
Aug. 31-May—	
Leavenworth	4
Lenape	31
Linwood	93
Logan County:	
Oct. 17—	
Oakley	1
Marshall County:	
Jan. 24-Apr. 5—	
Beattie	1
Marysville	1
Mitchell County:	
May 12—	
Beloit	1
Pawnee County:	
Oct. 19—	
Larned	1
Pottawatomie County:	
Dec.-Apr. 6—	
St. George	1
Wamego	88
Reno County:	
July 7-Aug. 9—	
Hutchinson	14
Saline County:	
Oct. 28-Jan. 18—	
Salina	2
Shawnee County:	
July 1-Apr. 6—	
Kiro	1
North Topeka	17
Rossville	1
Tecumseh	9
Topeka	367
Wabaunsee County:	
Aug. 18-23—	
Wabaunsee	2
Washington County:	
Jan. 1-Feb. 28—	
Hanover	2
Wyandotte County:	
Aug. 25-Dec.—	
Bonner Springs	5
Edwardsville	108
Loring	48
Kans., State total	1,411

KENTUCKY.

	Cars.
Bullitt County:	
Oct. 31—	
Shepherdsville	1
Fayette County:	
July 21-29—	
Chilesburg	3
Henderson County:	
Jan. 5-May 8—	
Henderson	3
Jefferson County:	
July 1-June 30—	
Anchorage	20
Buechel	115
Jeffersontown	23
Lakeland	2
Louisville	556
Lyndon	163
O'Bannon	117
Prospect	34
St. Matthews	326

KENTUCKY—Continued.

	Cars.
Laurel County:	
Feb.—	
East Bernstadt	1
McCracken County:	
July 28—	
Paducah	8
Oldham County:	
Aug. 4-23—	
Crestwood	26
Whitley County:	
Jan. 19—	
Williamsburg	1
Ky., State total	1,399

LOUISIANA.

Assumption Parish:	
May 10-June 15—	
Chula	2
Labadieville	10
Napoleonville	6
Avoyelles Parish:	
May 12-June 17—	
Bunkie	19
Cottonport	6
Evergreen	4
Long Bridge	2
Marksville	2
Bossier Parish:	
May 19-30—	
Benton	5
Caddo Parish:	
May 27—	
Shreveport	1
East Baton Rouge Parish:	
May 20-June 10—	
Baton Rouge	21
Bullion	2
East Feliciana Parish:	
May 15-June 1—	
Clinton	21
McManus	13
Slaughter	18
Evangeline Parish:	
June 2—	
Villa Platte	1
Iberia Parish:	
June 16—	
New Iberia	7
Iberville Parish:	
May 6-June 14—	
Bayou Goula	2
Grosse Tete	2
Maringouin	13
Plaquemine	11
White Castle	28
Lafayette Parish:	
June 3-16—	
Lafayette	5
Scott	1
Lafourche Parish:	
May 15-June 18—	
Lafourche	54
Lockport	218
Thibodaux	2
Natchitoches Parish:	
May-June 1—	
Derry	3
Natchitoches	1
Orleans Parish:	
May 20-Dec. 29—	
New Orleans	370
Ouachita Parish:	
June 16—	
Monroe	2
Pointe Coupee Parish:	
May 12-June 10—	
New Roads	20

LOUISIANA—Continued.

	Cars.
Rapides Parish:	
May 14-Dec. 31—	
Alexandria	252
Bijou	4
Boyce	1
Cheneyville	35
Lamorie	3
Meeker	1
Moreland	10
St. Helena Parish:	
May-Dec. 31—	
Grangeville	4
St. Landry Parish:	
May-Feb.—	
Arnaudville	21
Leonville	3
Morrows	1
Opelousas	6
Sunset	3
St. Martin Parish:	
June 3—	
Cade	1
St. Mary Parish:	
May 10-June 17—	
Adeline	1
Boeuf	1
Morgan City	1
Tangipahoa Parish:	
May 31—	
Natalbany	4
Tangipahoa	1
Terrebonne Parish:	
June 6-14—	
Schriever	11
Vermilion Parish:	
May 20—	
Frath	1
Washington Parish:	
May 21-July 2—	
Bogalusa	3
West Baton Rouge Parish:	
May 15-June 16—	
Addis	6
Erwinville	1
West Feliciana Parish:	
May 21-July 2—	
Bayou Sara	7
La., State total	1,254

MAINE.

Androscoggin County:	
Aug. 15-May 27—	
Auburn	3
Greene	18
Leeds Junction	1
Lisbon Falls	1
North Leeds	2
Sabattus	2
West Minot	3
Aroostook County:	
Aug. 14-June 17—	
Adaline	14
Ashland	318
Bridgewater	511
Bugbee	67
Caribou	3,347
Caribou Road	224
Carson	107
Colby	137
Crouseville	145
Crystal	184
Dyer Brook	149
Eagle Lake	61
Easton	949
Fairmount	383
Fort Fairfield	1,702
Fort Kent	537
Fox	85
Frenchville	289
Goodrich	590

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MAINE—Continued.

	Cars.
Aroostook County—Contd.	
Aug. 14–June 17—	
Grand Isle	216
Grimes Mill	451
Houlton	1,992
Island Falls	133
Jemtland	145
Keegan	13
Lille	166
Limestone	1,795
Littleton	185
Ludlow	127
Madawaska	100
Maple Grove	376
Mapleton	667
Margison	126
Mars Hill	1,088
Masardis	120
Maysville	177
Monticello	595
New Limerick	186
New Sweden	313
Oakfield	99
Park	87
Pauls	104
Perham	341
Phair	160
Portage	57
Presque Isle	2,299
Rands	19
Robinsons	303
St. David	82
St. Francis	18
St. John	19
St. Luce	178
Sands	25
Sheridan	11
Smyrna Mills	251
Soldier Pond	130
Squa Pan	151
Stockholm	106
Sweden	204
Van Buren	510
Wallagrass	24
Washburn	793
West Caribou	432
Westfield	445
West Prescue Isle	253
Winterville	13
Woodland Center	156
Wytopitlock	10
Cumberland County:	
Feb. 12—	
Portland	1
Franklin County:	
Aug. 20–May 29—	
East Wilton	6
Farmington	22
Kingfield	4
Phillips	2
Salem	8
West Farmington	14
Hancock County:	
Aug. 25–May 31—	
Bucksport	16
Goodwins	1
Nicolin	1
Kennebec County:	
Aug. 23–May 20—	
Albion	43
Augusta	9
Belgrade	19
China	17
Clinton	58
Gardiner	7
Hallowell	1
Monmouth	14
Oakland	19
Readfield	3
Vassalboro	8
Waterville	47
Weeks Mills	51

MAINE—Continued.

	Cars.
Kennebec County—Contd.	
Aug. 23–May 20—	
Winslow	1
Winthrop	14
Knox County:	
Nov.–Jan.—	
Union	7
Lincoln County:	
Nov. 3–May 2—	
South Newcastle	1
Winslows Mills	5
Wiscasset	3
Oxford County:	
Sept. 26–Feb. 25—	
Buckfield	1
Byron	1
East Hebron	3
Fryeburg	4
South Paris	4
Penobscot County:	
Aug. 25–June 10—	
Bangor	302
Bradford	19
Carmel	4
Corinna	195
Davidson	8
Dexter	155
Drew	5
East Millinocket	1
East Newport	182
Enfield	96
Etna	59
Hampden	22
Hermon Center	12
Hermon Pond	16
Holden	11
Hudson	15
Kingman	218
La Grange	84
Lincoln	46
Lincoln Center	130
Mattawamkeag	19
Newport Junction	150
North Bangor	26
Northern Maine Junction	3
Olamon	2
Passadumkeag	5
Patten	229
Seboois	5
Sherman	363
Silvers Mills	35
South Lagrange	23
Stacyville	19
Winn	176
Piscataquis County:	
Aug. 18–May 31—	
Abbot Village	28
Blanchard	1
Brownville	2
Brownville Junction	7
Derby	6
Dover and Foxcroft	213
East Dover	59
Greenville Junction	2
Guilford	78
Milo	67
Monson Junction	1
Sangerville	33
Shirley	5
South Sebec	152
Sagadahoc County:	
Nov. 3–Mar. 10—	
Richmond	39
Woolwich	1
Somerset County:	
Oct. 9–May 27—	
Anson	4
Bingham	17
Detroit	6
Embden	32
Harmony	11

MAINE—Continued.

	Cars.
Somerset County—Contd.	
Oct. 9–May 27—	
Hartland	143
Hinckley	57
Knox	2
Madison	9
Norridgewock	188
North Anson	29
Pittsfield	26
Shawmut	7
Skowhegan	141
Solon	100
Waldo County:	
Sept. 15–May 1—	
Belfast	1
Brooks	150
Burnham Junction	68
Frankfort	13
Palermo	59
Prospect	5
Stockton	2
Unity	85
Waldo	12
Winnecook	17
Winterport	25
Washington County:	
Sept. 28–May 24—	
Ayer's Junction	20
Calais	2
Columbia Falls	1
Danforth	118
Dennysville	6
Eaton	2
Forest	2
Jonesboro	1
Pembroke	1
Perry	5
Princeton	35
York County:	
Nov. 25–30—	
Buxton	1
Eastwood	1
Me., State total	31,228

MARYLAND.

Allegany County:	
Sept. 14–Jan. 11—	
Vale Summit	3
Anne Arundel County:	
Sept. 20–Feb. 16—	
Conway	6
Millersville	7
Naval Academy Junction	1
Baltimore City:	
June–May—	
Baltimore	2,170
Baltimore County:	
Aug. 25–Oct. 31—	
Arcadia	8
Hydes	1
White Hall	6
Carroll County:	
Aug.–Dec.—	
Greenmount	1
Hampstead	19
Hoods Mills	1
Lineboro	4
Maple Grove	7
Melrose	2
Westminster	11
Woodbine	1
Cecil County:	
Sept.–Oct. 27—	
Conowingo	2
Dorchester County:	
May 25–Dec.—	
East New Market	8
Hurlock	3

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MARYLAND—Continued.

	Cars.
Garrett County:	
May 15–Oct. 20—	
Deer Park Village	1
Oakland	2
Harford County:	
May 16—	
Forest Hill	1
Kent County:	
Aug. 14–Sept. 14—	
Chestertown	3
Still Pond	1
Worton	23
Prince Georges County:	
May 5–Dec. 26—	
Brown	2
Cheltenham	2
Laurel	34
Marlboro	8
Ritchie	1
Queen Annes County:	
May 3–Nov.—	
Love Point	6
Somerset County:	
June 27–Apr. 16—	
Costen	142
Crisfield (*see* Va.)	
Eden	7
Hopewell	1
Kings Creek	28
Kingston	27
Loretto	15
Marion	96
Princess Anne	88
Westover	24
Talbot County:	
May 3–Sept. 20—	
Chapel	2
Claiborne	6
Cordova	1
Wicomico County:	
June–Feb.—	
Fruitland	2
Rockawalking	3
Salisbury	1
Walstons	5
Worcester County:	
June 3–Apr. 30—	
Beaver Dam	172
Berlin	3
Friendship	2
Girdletree	59
Hursley	300
Pocomoke	302
Queponco	39
St. Martin	6
Showell	3
Snow Hill	309
Whaleyville	2
May–Oct.:	
Chester River landings	25
May–Nov.:	
Choptank River landings	11
July–Nov.:	
Nanticoke River landings	7
May–Nov.:	
Patuxent River landings	4
May–Nov.:	
Pocomoke River landings	626
May–Nov.:	
Potomac River landings	3
May–Nov.:	
Wicomico River landings	9
Md., State total	4,675

MASSACHUSETTS.

	Cars.
Berkshire County:	
Oct.–Dec. 11—	
Adams	1
Great Barrington	1
Lenox Dale	1
Richmond	1
Williamstown	4
Essex County:	
Oct. 1–Apr. 18—	
Beverly	2
Lawrence	9
Manchester	1
Franklin County:	
Aug. 10–May—	
Charlemont	11
Deerfield	1
Hampshire County:	
Nov.–June—	
Amherst	2
Easthampton	1
Northampton	4
Williamsburg	1
Middlesex County:	
Nov.–June—	
Marlboro	4
Stoneham	2
Waltham	2
Suffolk County:	
June 8–Dec. 5—	
Boston	59
Worcester County:	
July 25–May 15—	
Athol	5
Clinton	44
Otter River	3
Winchendon	1
Mass., State total	160

MICHIGAN.

	Cars.
Alcona County:	
Nov. 7–May 27—	
Greenbush	1
Harrisville	4
Allegan County:	
Sept. 1–May 31—	
Allegan	146
Bravo	3
Hamilton	13
Hilliards	21
Hopkins	9
Martin	14
Moline	1
Monteith	6
New Richmond	1
Otsego	34
Plainwell	59
Shelbyville	27
Wayland	14
Alpena County:	
Sept. 1–May 29—	
Lachine	24
Antrim County:	
Aug. 20–June 10—	
Alba	42
Alden	42
Antrim	1
Bellaire	40
Central Lake	93
Elk Rapids	48
Ellsworth	61
Mancelona	15
Baraga County:	
Oct. 8–Nov. 9—	
Baraga	10
Covington	2
Keweenaw Bay	3
L'Anse	1

MICHIGAN—Continued.

	Cars.
Barry County:	
Sept. 1–Mar. 11—	
Cloverdale	2
Delton	6
Doster	5
Freeport	5
Hastings	5
Irving	1
Middleville	12
Milo	3
Benzie County:	
Sept. 29–June 5—	
Bendon	5
Beulah	14
Cedar Run	36
Empire Junction	20
Frankfort	1
Honor	7
Lake Ann	5
Nessen City	33
Platte River	1
Thompsonville	9
Berrien County:	
Oct. 6–May 19—	
Benton Harbor	1
Berrien Center	6
Berrien Springs	2
Buchanan	6
Coloma	1
Fair Claire	29
Galien	1
Niles	6
Sawyer	1
Sodus	5
Watervliet	5
Branch County:	
Aug.–Dec.—	
Batavia	4
Bronson	39
Coldwater	6
Quincy	1
Union City	9
Calhoun County:	
Mar. 1–Apr. 1—	
Marshall	6
Cass County:	
Nov. 6–May 24—	
Cassopolis	3
Dowagiac	82
Edwardsburg	3
Marcellus	12
Penn	4
Pokagon	1
Wakelee	7
Charlevoix County:	
Oct. 31–May 16—	
Bay Shore	10
Boyne City	50
Boyne Falls	15
Charlevoix	18
Clarion	1
East Jordan	125
Cheboygan County:	
Oct.–Dec.—	
Aloha	5
Cheboygan	21
Tower	1
Wolverine	18
Chippewa County:	
Nov.—	
Trout Lake	1
Clare County:	
Mar. 31–May 9—	
Clare	1
Farwell	5
Harrison	10
Lake	28
Temple	2
Clinton County:	
Nov.—	
Frederic	3
St. Johns	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MICHIGAN—Continued.	Cars.
Delta County:	
Oct. 21–June 19—	
Bark River	15
Brampton	4
Escanaba	17
Naventa	16
Vans Harbor	7
Dickinson County:	
Nov. 3–June 21—	
Foster City	6
Iron Mountain	6
Loretto	6
Metropolitan	1
Norway	7
Waucedah	2
Eaton County:	
Oct.—	
Vermontville	1
Emmet County:	
Oct. 1–June 13—	
Alanson	5
Brutus	10
Carp Lake	3
Harbor Springs	9
Levering	63
Oden	1
Pellston	29
Petoskey	39
Gogebic County:	
Oct. 26—	
Bessemer	1
Grand Traverse County:	
Sept. 22–May 19—	
Fife Lake	84
Grawn	75
Kingsley	250
Old Mission	2
Traverse City	514
Walton	13
Walton Junction	37
Williamsburg	193
Gratiot County:	
Sept. 20–May 20—	
Alma	136
Riverdale	6
Hillsdale County:	
Nov.–Dec.—	
Hillsdale	3
Moscow	1
Reading	1
Houghton County:	
Oct. 30–Nov. 13—	
Houghton	2
Kenton	1
St. Marys Junction	1
Huron County:	
Oct. 1–Nov. 1—	
Kinde	7
Port Austin	4
Port Hope	12
Ingham County:	
Oct.–Dec. 31—	
Leslie	1
Mason	1
Ionia County:	
Oct. 5–June 15—	
Belding	86
Ionia	5
Orleans	46
Portland	3
Saranac	20
Shiloh	13
Smyrna	21
Iosco County:	
Nov. 3–May 8—	
Au Sable	1
East Tawas	1
Hale	1
McIver	1
Tawas City	3
Whittemore	5

MICHIGAN—Continued.	Cars.
Isabella County:	
Aug.–June—	
Blanchard	123
Weidman	45
Jackson County:	
Nov. 21–Apr. 19—	
Jackson	8
Springport	1
Kalamazoo County:	
Sept.–June 2—	
Alamo	47
Augusta	2
Galesburg	2
Kalamazoo	41
Pavilion	2
Schoolcraft	3
Scotts	6
Vicksburg	5
Williams	11
Yorkville	1
Kalkaska County:	
Oct. 3–May 18—	
Kalkaska	118
Rapid City	55
Rowley	129
Sigma	12
South Boardman	84
Kent County:	
Sept.–June 15—	
Ada	10
Alto	6
Byron Center	11
Cedar Springs	180
Fisher	2
Grand Rapids	86
Harvard	235
Kent City	7
Lowell	32
McCords	1
Moselev	63
Rockford	127
Sand Lake	146
Sparta	41
Lake County:	
Nov.–May—	
Edretts	10
Luther	60
Oliver	60
Lapeer County:	
Oct.–June 19—	
Attica	13
Columbiaville	12
Hunters Creek	1
Lum	11
Metamora	3
North Branch	5
Otter Lake	23
Leelanau County:	
Oct.–June 18—	
Cedar City	187
Empire	28
Glen Arbor	2
Glen Haven	20
Northport	81
Omena	53
Provemont	120
Solon	13
Suttons Bay	368
Lenawee County:	
July–Dec.—	
Adrian	1
Clinton	1
Rollin	15
Tecumseh	2
Woodstock	1
Livingston County:	
Mar. 17–May 30—	
Brighton	3
Howell	1
Luce County:	
Nov. 20—	
McMillan	1

MICHIGAN—Continued.	Cars.
Manistee County:	
Oct.–Mar.—	
Arcadia	40
Butwell	10
Chief Lake	44
Copemish	69
Henry	8
Kaleva	84
Malcolm	8
Manistee	1
Norwalk	28
Onekama	15
Sorenson	7
Springdale	1
Marquette County:	
Oct. 26–Dec. 12—	
Lawson	5
Marquette	11
Negaunee	1
Mason County:	
Nov.–June 30—	
Custer	46
Fountain	54
Freesoil	8
Ludington	77
Scottville	137
Mecosta County:	
Nov.–June—	
Barryton	70
Big Rapids	43
Mecosta	85
Millbrook	81
Morley	21
Paris	39
Remus	134
Rodney	69
Stanwood	7
Menominee County:	
Oct. 1–May 24—	
Banat	1
Daggett	25
Nadeau	4
Nathan	9
Spalding	3
Stephenson	6
Wallace	6
Wilson	2
Midland County:	
Nov.—	
Sanford	1
Missaukee County:	
Nov.–June—	
Falmouth	120
Lake City	86
Lucas	70
McBain	165
Monroe County:	
Oct.–Nov.—	
Dundee	1
Ida	1
Monroe	2
Petersburg	1
Montcalm County:	
Sept.–June—	
Amble	106
Coral	124
Edmore	581
Fenwick	7
Gowen	83
Greenville	465
Howard City	121
Lakeview	279
McBrides	114
Pierson	29
Sheridan	38
Sidney	126
Six Lakes	173
Stanton	131
Trufant	301
Vestaburg	36
Vickeryville	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MICHIGAN—Continued.

	Cars.
Montmorency County:	
Nov.-May—	
Hillman	7
Lewiston	2
Muskegon County:	
Oct.-June—	
Bailey	71
Brunswick	20
Casnovia	20
Holton	24
Montague	28
Muskegon	12
Slocum	30
Newaygo County:	
Oct.-June—	
Bitely	4
Fremont	80
Grant	66
Newaygo	14
Reeman	15
White Cloud	3
Woodville	18
Oakland County:	
Sept. 15-Dec. 31—	
Clarkston	5
Clyde	4
Highland	2
Holly	19
Leonard	8
Milford	30
Rochester	1
Rose Center	6
Waterford	2
Oceana County:	
Oct.-June—	
Hart	584
Mears	44
New Era	121
Pentwater	70
Shelby	141
Ogemaw County:	
Oct.-June—	
Lupton	5
Rose City	3
West Branch	8
Ontonagon County:	
Oct. 10-Dec. 10—	
Bruce's Crossing	4
Ontonagon	2
Paynesville	7
Rockland	1
Osceola County:	
Oct.-June—	
Ashton	38
Dighton	221
Evart	140
Hersey	65
Le Roy	80
Marion	35
Reed City	90
Sears	18
Tustin	126
West Tustin	19
Otsego County:	
Oct.-May—	
Elmira	62
Gaylord	110
Johannesburg	4
Vanderbilt	21
Ottawa County:	
Nov.-May—	
Conklin	15
Coopersville	3
Holland	1
Vriesland	1
West Olive	1
Zeeland	5
Presque Isle County:	
Oct.-Mar.—	
Metz	10
Millersburg	5

MICHIGAN—Continued.

	Cars.
Presque Isle County—Con.	
Oct.-Mar.—	
Posen	4
Rogers City	1
Roscommon County:	
Oct.-Nov.—	
Roscommon	5
Saginaw County:	
Aug.-Jan. 1—	
Birch Run	3
Saginaw	3
St. Clair County:	
Oct.-Mar.—	
Port Huron	2
St. Joseph County:	
Aug.-June—	
Burr Oak	38
Colon	7
Constantine	8
Findley	11
Klinger Lake	1
Leonidas	1
Mendon	3
Moorepark	3
Nottawa	4
Sturgis	4
Three Rivers	13
Sanilac County:	
May 29—	
McGregor	1
Schoolcraft County:	
Oct. 17-Nov. 29—	
Blaney	1
Cooks Mill	15
Manistique	9
Whitedale	1
Tuscola County:	
Oct.-May—	
Fostoria	27
Mayville	100
Silverwood	1
Vassar	3
Van Buren County:	
Oct.-June—	
Bangor	18
Berlamont	1
Bloomingdale	31
Breedsville	3
Decatur	7
Gobles	112
Hartford	13
Kendall	19
Kibbie	2
Lawrence	11
Lawton	18
McDonald	2
Paw Paw	31
Pullman	3
South Haven	2
Washtenaw County:	
Oct.-Dec.—	
Manchester	4
Saline	1
Wayne County:	
Sept.—	
Detroit	2
Eloise	1
Wexford County:	
Sept.-June—	
Boone	21
Buckley	163
Glengary	29
Harlan	39
Harrietta	20
Hobart	67
Manton	247
Mesick	53
Mich., State total	14,159

MINNESOTA.

	Cars.
Aitkin County:	
Oct.-June—	
Aitkin	12
Bain	4
Hill City	9
McGregor	3
Mississippi	10
Palisade	5
Red Top	11
Shovel Lake	1
Swatara	4
Tamarack	4
Anoka County:	
Sept.-June—	
Anoka	189
Bethel	417
Cold Springs	4
Coon Creek	1
Dayton	2
Twin City Stock Yards	13
Becker County:	
Sept.-June—	
Audubon	23
Callaway	16
Detroit	105
Frazee	47
Lake Park	157
Ogema	18
Beltrami County:	
Sept.-Dec.—	
Bemidji	29
Nebish	3
Pinewood	5
Puposky	1
Redby	2
Solway	17
Wilton	2
Benton County:	
Sept.-June—	
Foley	237
Rice	105
Sauk Rapids	32
Bigstone County:	
Oct.-May—	
Beardsley	6
Odessa	1
Blue Earth County:	
Oct. 7-May 29—	
Good Thunder	1
Mankato	1
Brown County:	
Oct.-Dec.—	
New Ulm	2
Sleepy Eye	6
Carlton County:	
Oct.-June—	
Atkinson	80
Barnum	13
Carlton	26
Cloquet	6
Cromwell	15
Kettle River	7
Mahtowa	15
Moose Lake	2
Wrenshall	24
Wright	8
Zebulon	1
Carver County:	
Mar. 30-June 3—	
Hamburg	4
Mayer	1
New Germany	1
Norwood	1
Waconia	2
Young America	1
Cass County:	
Oct.-Dec.—	
Boy River	5
Cass Lake	9
Pillager	15
Walker	5

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MINNESOTA—Continued.

	Cars.
Chippewa County:	
Mar. 2–May—	
Maynard	3
Watson	1
Chisago County:	
Sept.–June—	
Center City	45
Chisago City	41
Harris	70
Lindstrom	50
North Branch	198
Rush City	197
Shafer	48
Stacey	82
Taylor's Falls	2
Wyoming	17
Clay County:	
Sept.–June—	
Baker	278
Barnesville	476
Comstock	95
Dilworth	196
Downer	139
Felton	35
Georgetown	3
Glyndon	95
Hawley	586
Hitterdal	118
Kragnes	145
Manitoba Junction	10
Moorhead	36
Muskoda	67
Rustad	57
Sabin	536
Ulen	138
Clearwater County:	
Sept.–May—	
Bagley	36
Clearbrook	9
Gonvick	9
Leonard	6
Shevlin	24
Crow Wing County:	
Sept.–May—	
Brainerd	5
Cuyuna	1
Deerwood	1
Fort Ripley	71
Dakota County:	
Mar. 25–June 30—	
Hampton	3
Randolph	1
Rich Valley	2
Rosemount	10
South St. Paul	1
Dodge County:	
Jan.–May 24—	
Dodge Center	3
Eden	1
Douglas County:	
Sept.–June—	
Alexandria	33
Brandon	9
Carlos	88
Evansville	4
Forada	4
Garfield	89
Melby	3
Nelson	18
Osakis	60
Faribault County:	
Oct. 1—	
Winnebago	1
Freeborn County:	
Apr. 26—	
Twin Lake	1
Goodhue County:	
May 13–23—	
Cannon Falls	1
Goodhue	1

MINNESOTA—Continued.

	Cars.
Grant County:	
Oct.–June—	
Ashby	1
Barrett	3
Elbow Lake	2
Herman	3
Norcross	1
Wendell	1
Hennepin County:	
Aug.–July—	
Camden Place	64
Dayton	13
Hamel	5
Loretto	11
Maple Plain	2
Minneapolis	211
Minnehaha	23
Osseo	216
Oxboro Heath	27
Robbinsdale	3
Rogers	93
St. Bonifacius	4
Houston County:	
Nov. 3—	
Caledonia	1
Hubbard County:	
Aug.–July—	
Akeley	50
Nevis	30
Park Rapids	186
Isanti County:	
Aug.–July—	
Braham	234
Cambridge	661
Grandy	445
Isanti	621
Itasca County:	
Oct.–June—	
Bovey	1
Cohassett	14
Grand Rapids	57
Keewatin	1
Kennedy	29
Swan River	49
Warba	22
Kanabec County:	
Aug.–June—	
Grasston	125
Mora	396
Ogilvie	141
Kandiyohi County:	
Oct.–June—	
Atwater	3
Hawick	1
New London	2
Raymond	3
Spicer	6
Kittson County:	
Sept.–May—	
Bronson	16
Donaldson	9
Hallock	4
Halma	32
Humboldt	1
Lancaster	26
Northcote	6
Noyes	5
Lac Qui Parle County:	
Oct.–Mar.—	
Bellingham	6
Louisburg	1
Marietta	3
Nassau	5
Lake County:	
Oct.–Mar.—	
Morris	14
Lincoln County:	
Sept.–Apr.—	
Arco	3
Lake Benton	60
Verdi	9

MINNESOTA—Continued.

	Cars.
Lyon County:	
Mar. 23–June 16—	
Cottonwood	4
Minneota	7
Russell	2
McLeod County:	
May—	
Hutchinson	2
Plato	1
Mahnomen County:	
Oct. 20–Nov. 23—	
Mahnomen	5
Waubun	7
Marshall County:	
Oct.–May—	
Argyle	4
Holt	14
Middle River	2
Newfolden	1
Oslo	2
Radium	1
Stephen	9
Viking	1
Warren	1
Meeker County:	
Jan. 15–June 24—	
Darwin	1
Dassel	2
Eden Valley	3
Litchfield	1
Watkins	5
Millelacs County:	
Sept.–Apr.—	
Bock	31
Foreston	76
Milaca	29
Onamia	1
Princeton	1,329
Wahkon	3
Morrison County:	
Sept.–June—	
Belle Prairie	5
Bowlus	3
Cushing	3
Genola	11
Lincoln	7
Little Falls	57
Motley	33
Randall	2
Royalton	50
Swanville	28
Mower County:	
Oct.–Feb.—	
Le Roy	1
Lyle	1
Rose Creek	18
Nobles County:	
Sept.–May—	
Adrian	1
Ellsworth	3
Wilmont	1
Norman County:	
Sept.–June—	
Ada	84
Borup	39
Gary	24
Halstad	176
Hendrum	21
Lockhart	7
Perley	35
Shelly	79
Syre	2
Twin Valley	41
Olmsted County:	
Oct. 5–15—	
Haverhill	2
Ottertail County:	
Oct.–May—	
Battle Lake	17
Bluffton	25
Clitheral	2
Deer Creek	199
Dent	3

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MINNESOTA—Continued.

	Cars.
Ottertail County—Continued.	
Oct.-May—	
Elizabeth	3
Erharts	23
Fergus Falls	7
Henning	16
New York Mills	63
Ottertail	3
Parkers Prairie	250
Pelican Rapids	61
Perham	120
Richville	4
Underwood	8
Vergas	29
Pennington County:	
Sept.-June—	
St. Hilaire	5
Thief River Falls	46
Pine County:	
Sept.-June—	
Askov	44
Brook Park	17
Bruno	8
Denham	4
Finlayson	21
Groningen	14
Henriette	75
Hinckley	74
Kerrick	9
Marksville	5
Nickerson	1
Pine City	119
Rock Creek	45
Sandstone	14
Sturgeon Lake	6
Willow River	16
Pipestone County:	
Oct.-Apr.—	
Edgarton	3
Hatfield	1
Ihlen	1
Jasper	25
Pipestone	11
Trosky	2
Polk County:	
Sept.-May—	
Beltrami	13
Climax	423
Crookston	17
Dugdale	1
East Grand Forks	159
Eldred	44
Erskine	16
Euclid	1
Fertile	54
Fisher	10
Fosston	11
Glenwood	2
Gully	5
Lengby	6
Lowry	2
McIntosh	14
Mallory	43
Mentor	10
Nesbit	4
Nielsville	271
Trail	2
Winger	6
Pope County:	
Oct.-Apr.—	
Cyrus	2
Farwell	2
Starbuck	1
Villard	9
Westport	2
Ramsey County:	
Aug.-July—	
Hamline Transfer	1
Minnesota Transfer	126
New Brighton	3
St. Paul	50

MINNESOTA—Continued.

	Cars.
Red Lake County:	
Oct.-June—	
Brooks	4
Red Lake Falls	5
Redwood County:	
May 13—	
Belview	1
Renville County:	
May 20-June 10—	
Hector	2
Rice County:	
May 8-June 13—	
Northfield	3
Rock County:	
Nov.-Mar.—	
Luverne	7
Manley	1
Roseau County:	
Oct.-Dec.—	
Badger	7
Greenbush	3
Roseau	9
Warroad	10
St. Louis County:	
Sept.-July—	
Brookston	2
Chisholm	1
Duluth	43
Floodwood	9
Kelly Lake	3
Virginia	3
Scott County:	
Sept.-May—	
Prior Lake	2
Savage	15
Sherburne County:	
Aug.-May—	
Becker	58
Big Lake	67
Clear Lake	22
Elk River	210
Zimmerman	274
Stearns County:	
Aug.-June—	
Albany	20
Avon	29
Freeport	5
Greenwald	1
Holdingford	29
Kimball Prairie	4
Melrose	6
New Munich	1
Paynesville	4
Rockville	2
St. Cloud	84
St. Joseph	30
Sartell	8
Sauk Center	13
Steele County:	
Sept. 15-Nov. 10—	
Bixby	1
Hope	3
Owatonna	6
Stevens County:	
Jan.-June—	
Donnelly	6
Hancock	5
Swift County:	
Sept.-June—	
Appleton	6
Benson	13
Danvers	1
DeGraff	1
Holloway	4
Kerkhoven	3
Murdock	5
Todd County:	
Aug.-July—	
Bertha	136
Browerville	206
Burtrum	2
Clarissa	58
Eagle Bend	65

MINNESOTA—Continued.

	Cars.
Todd County—Continued.	
Aug.-July—	
Grey Eagle	22
Hewitt	76
Long Prairie	135
Philbrook	16
Round Prairie	17
Staples	37
West Union	6
Traverse County:	
Mar.-June—	
Browns Valley	11
Wheaton	1
Wabasha County:	
Oct.-June—	
Elgin	9
Kellogg	16
Plainview	16
Wadena County:	
Oct.-June—	
Aldrich	90
Menahga	68
Sebeka	42
Verndale	254
Wadena	281
Washington County:	
Oct.-June—	
Copas	35
Forest Lake	21
Hugo	2
Lake Elmo	1
Lakeland	1
Stillwater	15
Withrow	25
Watonwan County:	
Nov. 1—	
Madelia	1
Wilkin County:	
Sept.-May—	
Breckenridge	6
Campbell	2
Doran	1
Kent	8
Rothsay	206
Wolverton	104
Winona County:	
Oct.-May—	
Bethany	1
Lewiston	10
St. Charles	1
Utica	2
Winona	2
Wright County:	
Aug.-June—	
Albertville	88
Clearwater	5
Cokato	2
Delano	7
Hasty	13
Howard Lake	4
Maple Lake	8
Monticello	43
Montrose	3
Waverly	1
Yellow Medicine County:	
Oct.-June—	
Echo	2
Granite Falls	2
Hanley Falls	1
Minn., State total	18,191

MISSISSIPPI.

Adams County:	
May 26-June 10—	
Natchez	31
Stanton	4
Amite County:	
May-June—	
Gloster	8

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

MISSISSIPPI—Continued.

	Cars.
Copiah County:	
May 11–June 20—	
Crystal Springs	3
Hazlehurst	2
Forrest County:	
May 31–July 3—	
Hattiesburg	2
McLaurin	3
George County:	
May 1–June 15—	
Evanston	22
Lucedale	12
Harrison County:	
May—	
Biloxi	1
Jefferson County:	
May 31–June 7—	
McNair	3
Jefferson Davis County:	
May 27–June 12—	
Carson	3
Prentiss	7
Jones County:	
June 13–21—	
Laurel	2
Lamar County:	
June 3–8—	
Sumrall	3
Lauderdale County:	
June 1–13—	
Lauderdale	6
Lawrence County:	
May 31–June 3—	
Arm	2
Oakvale	1
Silver Creek	1
Lincoln County:	
June 17–23—	
Brookhaven	2
Marion County:	
May 26–June 9—	
Columbia	1
Hathorn	5
Sandy Hook	1
Pearl River County:	
May—	
Picayune	1
Simpson County:	
May 31—	
Magee	1
Walthall County:	
May 30—	
Knoxo	1
Miss., State total	128

MISSOURI.

	Cars.
Buchanan County:	
July–Mar. 26—	
St. Joseph	21
Chariton County:	
July–Sept.	
Brunswick	7
Dalton	3
Clay County:	
July 13–Aug. 25—	
Excelsior Springs Junction	28
Missouri City	18
Greene County:	
Dec. 30—	
Springfield	1
Holt County:	
Aug. 8–Oct. 28—	
Craig	1
Forest City	2
Jackson County:	
July–Mar.—	
Atherton	27
Blue Springs	1
Kansas City	48

MISSOURI—Continued.

	Cars.
Lafayette County:	
Oct. 1—	
Napoleon	1
Osage County:	
Sept.—	
Chamois	1
Ray County:	
July 1–Nov. 16—	
Camden	2
Floyd	76
Orrick	74
St. Charles County:	
Sept. 30—	
West Alton	1
St. Louis City:	
May 5–Dec. 27—	
St. Louis	111
Mo., State total	423

MONTANA.

	Cars.
Beaverhead County:	
Sept.–June—	
Apex	1
Armstead	2
Dillon	4
Glen	3
Big Horn County:	
Oct. 3–31—	
Hardin	3
Blaine County:	
Nov.–July—	
Chinook	8
Coburg	5
Harlem	5
Yantic	1
Zurich	5
Carbon County:	
Nov. 1–Dec. 30—	
East Bridger	8
Silesia	1
Cascade County:	
Aug.–June—	
Armington	2
Belt	4
Cascade	3
Fort Shaw	8
Geyser	2
Great Falls	6
Monarch	2
Raynesford	3
Simms	15
Chouteau County:	
Apr.–May—	
Big Sandy	9
Fergus County:	
Apr. 21–June—	
Hobson	1
Lewistown	4
Moccasin	1
Flathead County:	
Aug.–July—	
Columbia Falls	23
Kalispell	169
Somers	69
Gallatin County:	
Oct.–June—	
Bozeman	7
Manhattan	3
Hill County:	
Oct.–June—	
Box Elder	3
Chester	2
Havre	5
Hingham	1
Inverness	2
Kremlin	1
Jefferson County:	
Nov.–May—	
Boulder	2
Clancey	1
Piedmont	40

MONTANA—Continued.

	Cars.
Lewis and Clark County:	
Dec.–June—	
Craig	1
Gilman	2
Helena	59
Silver	8
Wolf Creek	1
Lincoln County:	
Nov.–Mar.—	
Eureka	30
Hershey	1
Troy	1
Madison County:	
Oct.–Apr.—	
Jefferson Island	39
Meagher County:	
Nov.–May—	
Judith Gap	1
Shawmut	2
Missoula County:	
Oct.–June—	
Lo Lo	8
Missoula	8
Musselshell County:	
Oct.—	
Musselshell	1
Powell County:	
Jan. 1–July 7—	
Deer Lodge	1
Race Track	2
Ravalli County:	
Sept.–June—	
Darby	4
Florence	2
Hamilton	165
Victor	23
Woodside	65
Richland County:	
Nov.–Dec.—	
Fairview	4
Sheridan County:	
Nov.–Mar.—	
Bainville	4
Flaxville	1
Medicine Lake	1
Redstone	3
Silverbow County:	
Oct.–June—	
Butte	22
Teton County:	
Nov.–June—	
Bynum	9
Choteau	1
Conrad	16
Cut Bank	2
Paris	1
Power	3
Toole County:	
Dec.–June—	
Devon	2
Dunkirk	3
Galata	1
Shelby	2
Sweet Grass	9
Virden	2
Valley County:	
Dec.—	
Tampico	1
Yellowstone County:	
July 19–Dec. 10—	
Billings	20
Huntley	2
Mont., State total	967

NEBRASKA.

	Cars.
Adams County:	
Oct.–Feb.—	
Hastings	5
Hayland	3
Juniata	2
Kenesaw	2

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NEBRASKA—Continued.

	Cars.
Antelope County:	
Oct.—	
Elgin	2
Boone County:	
Oct.—	
St. Edward	1
Box Butte County:	
Oct.–May—	
Alliance	437
Berea	16
Hemingford	407
Latan	8
Nye	6
Brown County:	
Sept. 5–Dec. 31—	
Ainsworth	184
Johnstown	33
Long Pine	56
Buffalo County:	
Oct.–June—	
Elm Creek	2
Kearney	22
Butler County:	
Oct.—	
Rising City	1
Cherry County:	
Oct.–Apr.—	
Crookston	10
Merriman	2
Valentine	22
Wood Lake	1
Cheyenne County:	
Nov.–Mar.—	
Dalton	21
Lodgepole	2
Potter	7
Sidney	17
Colfax County:	
Nov.—	
Schuyler	1
Custer County:	
Sept. 10–Nov. 20—	
Ansley	2
Broken Bow	2
Comstock	1
Merna	2
Sargent	2
Dakota County:	
Aug. 22–Sept. 15—	
Dakota City	6
Dawes County:	
Aug.–May—	
Belmont	122
Crawford	17
Fort Robinson	1
Marsland	63
Whitney	1
Deuel County:	
Oct.—	
Big Springs	1
Chappell	1
Dodge County:	
Aug.–May—	
Fremont	7
North Bend	1
Douglas County:	
Oct.–Apr.—	
Omaha	30
Valley	1
Gage County:	
Oct. 18—	
Clatonia	1
Garden County:	
Oct.–Apr.—	
Lewellen	8
Lisco	11
Oshkosh	6
Garfield County:	
Oct. 12–Nov. 8—	
Burwell	3
Grant County:	
Oct. 26–Nov. 7—	
Ashby	2

NEBRASKA—Continued.

	Cars.
Hall County:	
Aug.–Mar.—	
Doniphan	2
Grand Island	7
Wood River	2
Hooker County:	
Oct. 16–31—	
Mullen	3
Howard County:	
Nov. 1—	
Dannebrog	1
Keith County:	
Feb. 1–12—	
Brule	1
Keystone	4
Ogallala	4
Kimball County:	
Sept.–Apr.—	
Dix	17
Kimball	153
Oliver	1
Lancaster County:	
Aug.–June—	
Lincoln	20
Raymond	2
Lincoln County:	
Nov.–Apr.—	
Hershey	5
North Platte	5
Sutherland	1
Logan County:	
Mar.—	
Stapleton	5
Madison County:	
Aug.–June—	
Madison	1
Norfolk	8
Morrill County:	
Sept.–May—	
Angora	4
Bayard	13
Bridgeport	3
Broadwater	8
Northport	10
Nuckolls County:	
Feb. 26—	
Hardy	1
Otoe County:	
Sept. 6–23—	
Nebraska City	1
Palmyra	1
Platte County:	
Feb. 16–Apr. 29—	
Oconee	1
Platte Center	2
Redwillow County:	
Oct.—	
Lebanon	2
McCook	1
Rock County:	
Oct. 2–10—	
Newport	2
Saline County:	
Nov. 16—	
Western	1
Saunders County:	
Sept. 13–Oct. 25—	
Cedar Bluffs	1
Leshara	1
Wann	13
Scotts Bluff County:	
Sept.–May—	
Gering	1
Henry	12
McGrew	6
Melbeta	4
Mitchell	118
Morrill	234
Scotts Bluff	97
Toohey	1
Seward County:	
Oct. 13—	
Bee	1

NEBRASKA—Continued.

	Cars.
Sheridan County:	
Sept.–Jan.—	
Gordon	399
Hay Springs	109
Rushville	244
Sherman County:	
May 15—	
Loup City	1
Thayer County:	
Oct. 15–Nov. 30—	
Hebron	8
Thomas County:	
Oct. 10–Nov. 27—	
Seneca	5
Valley County:	
Oct. 5–Nov. 7—	
Ord	14
Washington County:	
Sept. 1—	
Fort Calhoun	1
Webster County:	
Nov. 6–25—	
Red Cloud	2
Nebr., State total	3,125

NEVADA.

Churchill County:	
Oct. 18–Nov. 24—	
Fallon	7
Lahontan	2
Douglas County:	
Nov.–Apr.—	
Minden	4
Esmeralda County:	
Nov. 4–25—	
Millers	6
Lyon County:	
Oct.–May—	
Churchill	59
Dayton	117
Fernley	1
Lyon	3
Mason	323
Wabuska	59
Weeks	7
Yerington	59
Mineral County:	
Oct. 7—	
Mina	1
Ormsby County:	
Sept.–Feb.—	
Carson City	24
Washoe County:	
Aug.–May—	
Franktown	1
Huffakers	1
Reno	99
Sparks	28
Verdi	1
Wadsworth	15
Washoe	3
Nev., State total	820

NEW HAMPSHIRE.

Belknap County:	
Nov.–June—	
Center Barnstead	7
Laconia	19
Meredith	1
Cheshire County:	
Sept.–Aug.—	
Keene	76
Walpole	1
Coos County:	
Sept.–June—	
Colebrook	124
Groveton	3
Lancaster	2
North Stratford	10
Percy	3

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NEW HAMPSHIRE—Contd.

	Cars.
Grafton County:	
Oct. 11–Nov. 4—	
Ashland	2
Blackmount	6
Bristol	2
Lisbon	1
Oliverian	6
Swainboro	6
West Thornton	1
Merrimack County:	
Oct.–May—	
Epsom	3
Pittsfield	2
Rockingham County:	
Oct.–Dec. 8—	
Epping	1
Salem	1
Strafford County:	
Aug.–Jan.—	
Rochester	1
Somersworth	6
Sullivan County:	
May 4–15—	
Newport	3
N. H., State total	287

NEW JERSEY.

	Cars.
Burlington County:	
July 27–Dec. 31—	
Atsion	4
Birmingham	9
Bordentown	49
Columbus	14
Cookstown	23
Hartford	12
Lewistown	2
Lumberton	67
Maple Shade	1
Marlton	8
Masonville	30
Medford	38
Mount Holly	69
Pemberton	21
Smithville	55
Stanwick Avenue	3
Vincentown	81
West Moorestown	21
Wrightstown	36
Camden County:	
July 15–Sept. 6—	
Blackwood	2
Grenloch	9
Cape May County:	
Nov.–Jan.—	
Cape May Court House	1
Dennisville	1
Goshen	1
Petersburg	1
Rio Grande	1
Seaville	1
South Dennis	1
Cumberland County:	
July–June—	
Bridgeton	400
Cedarville	1
Fairton	16
Finley	52
Greenwich	149
Heislerville	5
Husted	234
Leesburg	2
Mauricetown	1
Millville	13
Port Norris	4
Rosenhayn	2
Woodruff's	11
Essex County:	
Oct.–Apr.—	
Newark	1

NEW JERSEY—Continued.

	Cars.
Gloucester County:	
July 17–Nov. 6—	
Aura	43
Clayton	5
Glassboro	3
Harrisonville	49
Mickleton	3
Mullica Hill	119
Pitman	11
Richwood	58
Sewell	2
Swedesboro	6
Williamstown	11
Woodbury	5
Hudson County:	
Feb. 4–Dec. 29—	
Manhattan Piers	22
Weehawken	1
Hunterdon County:	
Sept. 23–Oct. 23—	
Annandale	2
Mercer County:	
Aug. 1–Nov. 17—	
Hightstown	920
Lawrence	116
Princeton Junction	158
Robbinsville	347
Trenton	17
Trenton Junction	1
Windsor	193
Yardville	222
Middlesex County:	
Aug.–Jan.—	
Cranbury	390
Dayton	6
Jamesburg	143
Lower Jamesburg	143
Monmouth Junction	31
Plainsboro	134
Prospect Plains	300
Monmouth County:	
July 12–Dec. 31—	
Allenwood	2
Belmar	40
Branchport	19
Cream Ridge	9
Davis	90
Farmingdale	11
Englishtown	417
Farmingdale	97
Freehold	1,152
Hazlet	176
Howell	997
Imlaystown	196
Manasquan	11
Marlboro	831
Middletown	40
Red Bank	173
Sharon	143
Shrewsbury	113
Spring Lake	4
Tennent	769
Wickatunk	225
Ocean County:	
Aug. 21–Nov. 20—	
Lakewood	2
New Egypt	47
Toms River	1
Salem County:	
July–Apr.—	
Daretown	418
Elmer	469
Monroeville	47
Norma	13
Palatine	289
Pedricktown	10
Penns Grove	2
Quinton	50
Salem	659
Woodstown	534
Somerset County:	
Aug. 24–Sept. 22—	
Kingston	10

NEW JERSEY—Continued.

	Cars.
Sussex County:	
Nov. 7—	
Branchville	1
Union County:	
Feb. 3—	
Elizabeth	1
Warren County:	
Sept. 8–Dec. 27—	
Allamuchy	4
Belvidere	16
Blairstown	1
Columbia	1
Stewartsville	4
N. J., State total	13,007

NEW MEXICO.

Bernalillo County:	
Oct. 1–Dec. 31—	
Albuquerque	4
Dona Ana County:	
July 6–12—	
Dona Ana	1
McKinley County:	
Oct. 10–30—	
Perea	3
Otero County:	
Sept. 28–Nov. 28—	
Cloudcroft	32
Rio Arriba County:	
Dec. 8—	
Chama	1
San Juan County:	
Nov. 6—	
Aztec	1
N. Mex., State total	42

NEW YORK.

Albany County:	
Oct.—	
Albany	5
Allegany County:	
Sept.–June—	
Almond	27
Andover	97
Angelica	9
Birdsall	11
Burns	6
Canaseraga	110
Caneadea	3
Ceres	2
Fillmore	30
Friendship	1
Garwoods	2
Mapes	9
Rossburg	11
Rushford	1
Scio	2
Swain	7
Wellsville	54
Whitesville	61
Broome County:	
Sept.–May—	
Binghampton	1
Center Village	1
Chenango Bridge	1
Chenango Forks	5
Conklin	5
Killawog	4
Kirkwood	3
Lisle	19
Nineveh	15
Tunnel	6
Union	4
Vestal	8
Whitney Point	13
Windsor	4
Cattaraugus County:	
Oct. 23–31—	
Freedom	1
Randolph	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NEW YORK—Continued.

	Cars.
Cayuga County:	
Oct.-May—	
Auburn	8
Genoa	3
Martville	7
Montezuma	1
Mora ia	55
North Port Byron	3
Sennett	13
Venice Center	2
Weedsport	24
Chautauqua County:	
Nov. 2-June 24—	
Jamestown	1
Ripley	2
Chemung County:	
Nov.-Feb.—	
Elmira	1
Horseheads	5
Mill Port	2
Van Etten	3
Wellsburg	1
Chenango County:	
Sept. 9-Nov. 15—	
Afton	39
Greene	11
Mount Upton	2
New Berlin	8
New Berlin Junction	3
Norwich	1
Oxford	9
Rockdale	2
Sherburne	56
Sherburne Four Corners	2
Smyrna	10
South New Berlin	2
Clinton County:	
Sept.-June—	
Altona	24
Ausable Forks	10
Beekmantown	1
Cadyville	251
Cherubusco	61
Ellenburg	111
Forest	1
Mooers Forks	6
Peru	135
Plattsburg	1
Russia	5
Columbia County:	
Sept. 30-Dec 10—	
Boston Corners	2
East Chatham	3
Cortland County:	
Sept.-May—	
Blodgett Mills	11
Cincinnatus	25
Cortland	31
Cuyler	11
East Freetown	4
East Homer	4
Gee Brook	6
Homer	29
Little York	41
McGraw	40
Marathon	21
Messengerville	11
Mills	10
North Harford	17
Truxton	1
Delaware County:	
Oct. 3-Nov. 21—	
Bloomville	2
Da enport Center	14
Delhi	7
Hamden	2
Hobart	7
Kortright Station	1
Maywood	5
Northfield	2
Roxbury	2
Sidney	1
Stamford	29

NEW YORK—Continued.

	Cars.
Delaware County—Contd.	
Oct. 3-Nov. 21—	
Walton	6
Youngs	3
Dutchess County:	
July 23-Dec. 15—	
Bangall	5
Pine Plains	1
Poughquag	1
Stormville	1
Wingdale	1
Erie County:	
Aug.-June—	
Alden	3
Buffalo	7
Buffalo Creek	2
Chaffee	2
Colden	1
East Aurora	33
North Collins	6
Protection	1
South Wales	7
West Falls	14
Essex County:	
Nov.-Mar.—	
Bloomingdale	7
Port Kent	21
Ticonderoga	1
Franklin County:	
Sept.-June—	
Bangor	53
Brushton	96
Burke	83
Chateaugay	345
Constable	2
Dickinson Center	1
Gabriels	3
Lake Clear Junction	1
Loon Lake	2
Malone	104
Moira	2
Mountain View	1
Owlshead	15
Tupper Lake	2
Genesee County:	
Oct.-May—	
Alabama	39
Alexander	2
Batavia	44
Byron	47
Darien	9
Darien Center	9
D. L. & W. Junction	1
East Bethany	8
East Pembroke	22
Elba	41
Le Roy	18
Oakfield	9
Pavilion Center	4
Pembroke	9
South Byron	22
Stafford	41
Greene County:	
Sept.—	
Catskill	1
Herkimer County:	
Oct. 27-Nov. 8—	
Cedarville	1
South Columbia	1
South Little Falls	1
West Winfield	1
Jefferson County:	
Oct.—	
Cape Vincent	1
Carthage	1
Lafargeville	4
Philadelphia	1
Sacket Harbor	1
Kings County:	
Oct.—	
Brooklyn	3

NEW YORK—Continued.

	Cars.
Lewis County:	
Oct.-Nov.—	
Lyons Falls	3
Livingston County:	
Oct.-June—	
Avon	26
Caledonia	3
Conesus	3
Dalton	31
Dansville	39
Hemlock	8
Hunt	29
Inverness	5
Lima	21
Livonia	23
South Lima	1
South Livonia	1
Springwater	18
Madison County:	
Oct.-May—	
Chittenango	1
De Ruyter	22
Earlville	6
Erietown	3
Georgetown	2
Hamilton	1
Hubbardsville	14
Lebanon	1
Leonardsville	4
New Woodstock	6
North Brookfield	7
North Chittenango	1
Poolville	5
Randallsville	3
Sheds Corners	10
Solsville	1
West Edmeston	1
Monroe County:	
Sept.-June—	
Adams Basin	10
Brockport	12
Elm Grove	1
Fairport	38
Garbutt	1
Hamlin	1
Henrietta	5
Hilton	1
Honeoye Falls	35
Mendon	12
Mumford	15
Pittsford	1
Rochester	5
Rochester Junction	19
Rush	1
Spencerport	10
Wadsworth Junction	1
Wayneport	9
West Henrietta	25
West Rush	3
Nassau County:	
Sept.-Jan.—	
Central Park	15
East Williston	1
Farmingdale	20
Hicksville	12
Massapequa	5
Syosset	70
New York County:	
Aug.-July—	
New York	110
Niagara County:	
Nov.—	
Barker	6
Gasport	1
North Tonawanda	1
Oneida County:	
Sept.-Nov. 9—	
Blossvale	1
Bridgewater	2
Camden	2
Clinton	2
Deansboro	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NEW YORK—Continued.

	Cars.
Oneida County—Contd.	
Sept.-Nov. 9—	
Paris	5
Richfield Junction	10
Utica	4
Waterville	5
Onondaga County:	
Aug.-July—	
Apulia	13
Baldwinsville	11
Camillus	1
Clay	1
Halfway	12
Jordan	7
Kirkville	8
Lamson	13
Martisco	32
Memphis	15
Onativia	2
Oran	1
Skaneateles Junction	57
Syracuse	7
Tully	67
Ontario County:	
Oct.-June—	
Clifton Springs	70
Farmington	19
Fishers	71
Geneva	13
Ionia	37
Manchester	2
Mertensia	1
Naples	53
Oaks Corners	13
Phelps	84
Phelps Junction	22
Seneca Castle	4
Shortsville	1
Victor	53
Orleans County:	
Nov.-Dec.—	
Albion	4
Ashwood	6
Knowlesville	3
Medina	2
Oswego County:	
Nov.-Mar.—	
Bernhards	1
Fulton	3
Hannibal	3
Kasoag	1
New Haven	4
South Granby	7
Otsego County:	
Sept.-May—	
Cherry Valley	7
Cooperstown	4
East Worcester	47
Edmeston	18
Fly Creek	6
Laurens	4
Maryland	14
Mount Vision	3
Oneonta	9
Otego	16
Richfield Springs	5
Schenevus	21
Schuyler Lake	9
Unadilla	2
Wells Bridge	5
Worcester	87
Rensselaer County:	
Sept.-Mar.—	
Berlin	2
Buskirk	38
Hoosick	35
Hoosick Falls	7
Johnsonville	40
North Hoosick	10
Petersburg	3
Schaghticoke	10
Stephentown	1

NEW YORK—Continued.

	Cars.
Rensselaer County—Contd.	
Sept.-Mar.—	
Valley Falls	11
Van Hoesen	1
Walloomsac	12
West Valley Falls	3
St. Lawrence County:	
Oct.-Mar.—	
Canton	1
Eben	3
North Lawrence	15
Potsdam	1
Saratoga County:	
Nov. 6–Dec. 7—	
Gansevoort	3
Schuylerville	8
Schoharie County:	
Sept.-Dec.—	
Hyndsville	1
Middleburg	1
Richmondville	15
Schoharie	1
South Gilboa	8
Schuyler County:	
Oct.-May—	
Alpine	6
Beaver Dams	11
Odessa	21
Watkins	2
Seneca County:	
Oct.-Nov.—	
Caywood	1
Junius	17
Lodi	2
Sheldrake Springs	1
Waterloo	6
Steuben County:	
Sept.-June—	
Addison	6
Adrian	3
Arkport	163
Atlanta	124
Avoca	74
Bath	15
Cameron	11
Cameron Mills	1
Campbell	8
Canisteo	12
Cohocton	114
Coopers	5
Corning	2
Freeman	4
Greenwood	23
Hammondsport	12
Hornell	48
Kanona	36
Lindley	2
Painted Post	1
Portway	77
Prattsburgh	18
Rexville	43
Rogersville	115
Savona	4
Wallace	174
Wayland	275
Wheeler	18
Suffolk County:	
July-May—	
Amagansett	1
Aquebogue	360
Bridgehampton	287
Calverton	122
Cutchogue	316
Deer Park	5
Easthampton	4
East Moriches	4
Eastport	3
Greenlawn	6
Greenport	23
Huntington	3
Jamesport	191
Kings Park	1

NEW YORK—Continued.

	Cars.
Suffolk County—Contd.	
July-May—	
Laurel	105
Manorville	16
Mattituck	257
Medford	2
Millers Place	14
Northport	10
Orient	228
Peconic	140
Pine Lawn	11
Port Jefferson	5
Riverhead	605
Shelter Island	5
Southampton	73
Southold	259
Wading River	13
Wainscott	53
Watermill	200
Wyandanch	1
Yaphank	2
Sullivan County:	
Sept. 11–Nov. 6—	
Cochecton	2
Narrowsburg	3
Tioga County:	
Sept.-Jan.—	
Apalachin	41
Barton	2
Berkshire	17
Campville	7
Candor	19
Flemingville	10
Lockwood	3
Lounsberry	4
Newark Valley	13
Nichols	40
North Spencer	1
Owego	32
Richford	38
Smithboro	1
Spencer	9
Tioga Center	4
West Candor	5
Wilseyville	3
Tompkins County:	
Oct.-June—	
Brookton	10
Caroline	3
Dryden	42
Etna	6
Groton	15
Ithaca	1
Lake Ridge	1
McLean	38
Newfield	1
North Lansing	12
Ulster County:	
Oct.-Nov.—	
Esopus	1
Kingston	10
Washington County:	
Sept.-May—	
Cambridge	88
Fort Edward	36
Granville	13
Salem	89
Shushan	37
Smith's Basin	42
White Creek	8
Wayne County:	
Oct.-June—	
Clyde	1
East Palmyra	2
Lyons	41
Macedon	4
Marion	6
Newark	26
North Macedon	12
North Newark	4
North Rose	2

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NEW YORK—Continued.

	Cars.
Wayne County—Contd.	
Oct.–June—	
Ontario	1
Palmyra	13
Port Gibson	7
Red Creek	1
Savannah	7
Sodus Center	7
Wallington	1
Walworth	1
Williamson	1
Wyoming County:	
Sept.–May—	
Arcade	1
Bliss	52
Curriers	1
Eagle	7
Gainsville	52
Hardys	63
Java Center	3
Portage	2
Portageville	4
Rock Glen	10
Warsaw	7
Yates County:	
Oct.–Dec. 29—	
Bellona	4
Earl	13
N. Y., State total	10,765

NORTH CAROLINA.

	Cars.
Ashe County:	
Mar. 19—	
Riverside	1
Avery County:	
Jan. 28—	
Montezuma	1
Beaufort County:	
May 15–July 1—	
Bishop Cross	2
Washington	287
Bladen County:	
June 28—	
Abbottsburg	1
Buncombe County:	
Aug. 12—	
Hominy	1
Camden County:	
June 13–29—	
Belcross	58
Carteret County:	
Dec.–Jan.—	
Morehead City	97
Catawba County:	
Apr. 26–June 15—	
Conover	3
Columbus County:	
June 10–13—	
Chadbourn	3
Lake Waccamaw	1
Craven County:	
June–July—	
Newbern	225
Cumberland County:	
July 22–Aug. 5—	
Fayetteville	25
Currituck County:	
June 2–July 5—	
Moyock	11
Shawboro	2
Peninsula shipments via Elizabeth City	425
Duplin County:	
June–July—	
Calypso	297
Faison	11
Warsaw	6
Edgecombe County:	
June 6–28—	
South Rocky Mount	6

NORTH CAROLINA—Contd.

	Cars.
Gates County:	
June 14–July 12—	
Sunbury	13
Trotville	1
Wardville	1
Halifax County:	
June 10–25—	
Hobgood	3
Palmyra	12
Haywood County:	
Aug. 1–Nov. 20—	
Canton	13
Clyde	5
Waynesville	5
Woodrow	2
Henderson County:	
Aug.–May—	
Flat Rock	1
Fletcher	1
Hendersonville	23
Johnston County:	
July 20–Aug. 3—	
Clayton	44
Lenoir County:	
June 14–July 6—	
Kinston	9
Martin County:	
May 20–June 28—	
Everetts	16
Parmele	1
Robertsonville	6
Mitchell County:	
Nov. 3—	
Spruce Pine	1
New Hanover County:	
June 2–20—	
Castle Hayne	18
Wilmington	57
Pamlico County:	
June 1–Aug. 1—	
Oriental	11
Vandemere	50
Pasquotank County:	
June 10–24—	
Elizabeth City (see Currituck County.)	
Okisko	4
Pender County:	
May 29–June 10—	
Rocky Point	22
Perquimans County:	
June 14—	
Chapanoke	1
Pitt County:	
June 13–16—	
Grimesland	5
Simpson	2
Polk County:	
June 10—	
Saluda	1
Robeson County:	
June 6–July 14—	
Lumberton	2
Parkton	14
Sampson County:	
June–July—	
Clinton	4
Surry County:	
Aug. 22–Oct. 15—	
Mount Airy	22
Swain County:	
Aug. 15–Nov. 1—	
Whittier	4
Washington County:	
May 1–30—	
Plymouth	4
Wayne County:	
May 31–July 17—	
Dudley	6
Goldsboro	23

NORTH CAROLINA—Contd.

	Cars.
Wayne County—Contd.	
May 31–July 17—	
Mt. Olivet	410
Pikeville	2
N. C., State total	2,282

NORTH DAKOTA.

	Cars.
Barnes County:	
Oct.–June—	
Dazey	20
Leal	7
Litchville	1
Oriska	3
Pillsbury	20
Rogers	3
Sanborn	7
Valley City	2
Wimbledon	5
Benson County:	
Oct. 4–Dec.—	
Baker	2
Brinsmade	2
Esmond	6
Fillmore	3
Hesper	1
Leeds	4
Maddock	1
Minnewaukan	2
Oberon	3
Pleasant Lake	1
Tolna	1
York	2
Bottineau County:	
Oct. 14–Dec.—	
Bottineau	9
Carbury	1
Hurd	1
Landa	3
Lansford	1
Newburg	19
Omemee	9
Roth	1
Souris	4
Westhore	4
Willow City	4
Bowman County:	
Dec.–June—	
Bowman	12
Burke County:	
Nov.–Apr.—	
Columbus	1
Powers Lake	2
Burleigh County:	
Oct.–June—	
Bismarck	12
Burleigh	2
Moffit	1
Regan	1
Cass County:	
Aug.–June—	
Absaraka	46
Amenia	17
Arthur	14
Ayr	56
Buffalo	45
Casselton	5
Chaffee	22
Davenport	1
Erie	23
Fargo	17
Gardner	1
Grandin	1
Harwood	15
Hickson	2
Horace	17
Hunter	107
Kindred	25
Leonard	16
Mapleton	23

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NORTH DAKOTA—Contd.

	Cars.
Cass County—Continued.	
Aug.-June—	
Page	98
Prosper	19
Tower City	3
Warren	15
Wheatland	2
Wild Rice	9
Woods	1
Cavalier County:	
Oct.-May—	
Alsen	1
Calvin	1
Easby	1
Hannah	3
Langdon	3
Milton	5
Munich	1
Osnabrock	2
Sarles	3
Union	2
Weaver	1
Dickey County:	
Oct.-Apr.—	
Ellendale	3
Forbes	6
Guelph	2
Ludden	2
Oakes	9
Pehl	2
Divide County:	
Nov.-May—	
Crosby	7
Noonan	3
Dunn County:	
Oct.-Dec.—	
Killdeer	2
Werner	1
Eddy County:	
Oct.-Mar.—	
Brantford	5
Hamar	1
New Rockford	9
Foster County:	
Sept.-Mar.—	
Bordulac	8
Carrington	19
Glenfield	2
Grace City	11
McHenry	4
Grand Forks County:	
Oct.-June—	
Emerado	5
Gilby	26
Grand Forks	136
Honeyford	1
Kempton	11
Larimore	74
Manvel	1
Mekinock	1
Niagara	15
Northwood	5
Reynolds	2
Thompson	119
Griggs County:	
Oct.-Mar.—	
Binford	2
Cooperstown	2
Hannaford	10
Jessie	1
Karnak	15
Sutton	6
Walum	5
Hettinger County:	
Oct.-Dec.—	
Mott	4
Kidder County:	
Oct.-Dec.—	
Dawson	2
Steele	2

NORTH DAKOTA—Contd.

	Cars.
LaMoure County:	
Apr. 24-June 5—	
Alfred	1
Edgeley	6
LaMoure	4
Marion	1
Mortonville	1
Verona	8
McHenry County:	
Oct.-Nov.—	
Bantry	1
Berwick	2
Drake	1
Towner	6
Upham	4
McIntosh County:	
Mar. 11-May 23—	
Ashley	7
Venturia	3
McKenzie County:	
Oct.-Dec.—	
Alexander	5
Arnegard	1
Cartwright	1
Charbonneau	3
Watford	2
McLean County:	
Oct. 10-20—	
Underwood	6
Washburn	1
Wilton	4
Mercer County:	
Oct.-Dec.—	
Hazen	2
Morton County:	
May 22—	
Flasher	2
Raleigh	1
Mountrail County:	
Nov.-June—	
Coulee	1
Palermo	1
Ross	3
Tagus	1
White Earth	2
Nelson County:	
Sept.-June—	
Aneta	9
Dahlen	1
Lakota	9
Michigan	2
Petersburg	19
Tolna	4
Whitman	1
Oliver County:	
Oct.-Dec.—	
Fort Clark	1
Sanger	2
Pembina County:	
Oct.-June—	
Backoo	4
Bathgate	8
Cavalier	78
Crystal	23
Drayton	9
Glasston	15
Hamilton	2
Hensel	3
Mountain	1
Pembina	21
Walhalla	85
Pierce County:	
Oct.-Nov.—	
Barton	2
Rugby	8
Ramsey County:	
Oct.-Apr.—	
Church's Ferry	4
Derrick	4
Devils Lake	21
Doyon	1
Edmore	2
Lawton	2

NORTH DAKOTA—Contd.

	Cars.
Ramsey County—Contd.	
Oct.-Apr.—	
Penn	1
Southam	3
Ransom County:	
Oct.-Dec.—	
Buttzville	2
Englevale	3
Lisbon	1
Renville County:	
Oct.-Dec.—	
Glenburn	3
Loraine	2
Mohall	4
Sherwood	4
Richland County:	
Oct.-July—	
Abercrombie	8
Barney	2
Christine	3
Colfax	4
Fairmount	8
Galchutt	1
Hankinson	17
Lidgerwood	4
Mantador	2
Wahpeton	6
Walcott	4
Wyndmere	2
Rolette County:	
Sept. 25-Dec.—	
Dunseith	13
Mylo	2
Nanson	1
Rolette	13
Rolla	5
St. John	12
Sargent County:	
Nov.-June—	
Brampton	7
Cayuga	6
Cogswell	1
De Lamere	1
Havana	6
Milnor	4
Rutland	3
Sheridan County:	
Oct.—	
McClusky	1
Steele County:	
Nov.-June—	
Colgate	2
Finley	6
Hope	10
Luverne	2
Stutsman County:	
Sept.-Feb.—	
Buchanan	2
Courtenay	7
Edmunds	2
Jamestown	10
Kensal	5
Medina	2
Millartown	1
Pingree	4
Windsor	2
Woodworth	2
Towner County:	
Oct.-Apr.—	
Bisbee	4
Cando	10
Egeland	3
Maza	4
Perth	3
Traill County:	
Oct.-July—	
Blanchard	1
Buxton	21
Clifford	5
Cummings	7
Galesburg	24
Hatton	10
Hillsboro	54

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

NORTH DAKOTA—Contd.

	Cars.
Traill County—Continued.	
Oct.-July—	
Kelso	16
Mayville	5
Portland	1
Walsh County:	
Sept.-May—	
Ardock	2
Auburn	17
Cashel	6
Edinburg	4
Grafton	68
Hoople	253
Minto	2
Park River	16
Ward County:	
Oct.-June—	
Berthold	187
Des Lacs	2
Hartland	4
Kenaston	1
Kenmare	1
Logan	2
Lone Tree	1
Makoti	2
Ryder	2
Sawyer	3
Surrey	1
Wells County:	
Oct. 11-Nov. 29—	
Cathay	1
Harvey	2
Heaton	1
Hurdsfield	1
Sykestown	2
Williams County:	
Oct.-Jan.—	
Ray	4
Spring Brook	1
Tioga	2
Wild Rose	1
Williston	16
N. Dak., State total	2,758

OHIO.

	Cars.
Allen County:	
Nov.-Apr.—	
Lima	4
Ashtabula County:	
Sept.-May—	
Andover	1
Ashtabula	7
Ashtabula Harbor	50
Conneaut	7
East Orwell	1
Geneva	4
Kingsville	13
Rock Creek	3
Simmons	1
Auglaize County:	
Nov. 9—	
St. Marys	1
Belmont County:	
May—	
Martins Ferry	1
Champaign County:	
Oct.—	
St. Paris	1
Clark County:	
Oct.—	
Greenville	1
Clermont County:	
Oct.—	
Perintown	1
Columbiana County:	
Aug.-Apr.—	
Columbiana	1
East Liverpool	2
Kensington	1
Lisbon	7
Moultrie	2

OHIO—Continued.

	Cars.
Columbiana County—Con.	
Aug.-Apr.—	
New Waterford	2
Salem	2
Summitville	6
Washingtonville	1
Coshocton County:	
Jan.-May—	
Coshocton	2
Crawford County:	
Aug.-Nov.—	
Bucyrus	11
Robinson	1
Cuyahoga County:	
Aug.-June—	
Cleveland	6
Erie County:	
Nov.-June	
Avery	12
Berlin Heights	11
Castalia	5
Ceylon	9
Huron	11
Kimball	4
Milan	31
Sandusky	1
Shinrock	27
Vermillion	3
Franklin County:	
Jan. 1-Dec. 31—	
Columbus	6
Fulton County	
Dec.—	
Delta	1
Fayette	1
Geauga County:	
Nov.-Mar.—	
East Claridon	8
Greene County:	
Nov.-Apr.	
Xenia	5
Guernsey County:	
Oct.-Jan.—	
Cambridge	2
Hamilton County:	
Sept.-June—	
Cincinnati	33
Cleves	1
Hardin County:	
Oct. 20-May—	
Ada	3
Dola	2
Huron County:	
Oct.-June	
Bellevue	7
Collins	4
Monroeville	2
New London	6
Norwalk	3
Jefferson County:	
Dec.-Feb.—	
Steubenville	6
Knox County:	
Aug. 31-Oct. 14—	
Ankenytown	4
Danville	1
Lake County:	
Nov.-June—	
Madison	28
Mentor	1
Painesville	6
Perry	5
Unionville	4
Licking County:	
Nov.—	
Newark	3
Logan County:	
Nov. 1-27—	
Bellefontaine	3
Lorain County:	
Oct.—	
Brighton	1

OHIO—Continued.

	Cars.
Lucas County:	
Oct.-June—	
Sylvania	1
Toledo	12
Madison County:	
Oct.—	
London	2
Mahoning County:	
Apr.—	
Youngstown	1
Marion County:	
Oct.-Dec.—	
Marion	4
Medina County:	
Nov.-May—	
Burbank	3
Monroe County:	
Oct.—	
Ozark	1
Montgomery County:	
Dec.-Jan.—	
Dayton	2
Muskingum County:	
Nov.-May—	
Zanesville	2
Perry County:	
Dec.—	
New Lexington	1
Portage County:	
Oct.-June—	
Atwater	1
Aurora	12
Earlville	5
Freedom	7
Garrettsville	22
Hiram	3
Mahoning	7
Mantua	101
Ravenna	44
Rootstown	4
Wayland	1
Putnam County:	
Apr.-May 2—	
Columbus Grove	2
Richland County:	
Aug. 23-Oct. 23—	
Belleville	42
Butler	1
Mansfield	1
Ross County:	
Sept. 15-Dec. 3—	
Chillicothe	1
Vigo	2
Sandusky County:	
Aug. 31-Nov. 6—	
Clyde	18
Colby	6
York	1
Seneca County:	
Nov.-May—	
Green Springs	18
Old Fort	4
Tiffin	1
Stark County:	
Dec.-Mar.—	
Alliance	1
Canton	17
Magnolia	2
Summit County:	
Oct.-Dec.—	
Akron	4
Trumbull County:	
Sept.-Dec.—	
Kinsman	1
Niles	1
Warren	1
Tuscarawas County:	
May—	
New Comerstown	1
Van Wert County:	
May—	
Van Wert	1

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

OHIO—Continued.

	Cars.
Washington County:	
Aug. 18–Nov. 2—	
Lowell	5
Marietta	3
Relief	2
Swifts	3
Whipple	2
Wayne County:	
Sept. 12–Nov. 2—	
Creston	3
Funk	2
Orrville	10
Smithville	17
Wooster	5
Wyandot County:	
Oct.—	
Upper Sandusky	1
Wharton	6
Ohio, State total	821

OKLAHOMA.

	Cars.
Beckham County:	
Mar. 2–20—	
Erick	2
Cherokee County:	
June 28–July 1—	
Tahlequah	3
Haskell County:	
June 14–20—	
McCurtain	3
Stigler	6
Hughes County:	
June 21–23—	
Wetumka	3
La Flore County:	
June 9–July 14—	
Bokoshe	1
Cameron	2
Hodgens	1
Poteau	13
Shady Point	1
Spiro	249
McCurtain County:	
May 29–30—	
Idabel	2
McIntosh County:	
June—	
Eufaula	4
Muskogee County:	
June 2–Jan. —	
Braggs	26
Fort Gibson	461
Haskell	14
Keefeton	2
Muskogee	47
Porum	1
Webbers Falls	166
Wybark	64
Okfuskee County:	
June–July—	
Castle	8
Okemah	5
Weleetka	33
Pottawatomie County:	
June–Jan.—	
Dale	5
Shawnee	57
Seminole County:	
June—	
Konawa	2
Sequoyah County:	
June 8–Nov. 3—	
Gans	16
Gore	68
Muldrow	41
Redland	19
Rowland	3
Sallisaw	1
Vian	44

OKLAHOMA—Continued.

	Cars.
Tulsa County:	
May 9—	
Tulsa	1
Wagoner County:	
June 19–July 5—	
North Muskogee	20
Redbird	12
Wagoner	18
Okla., State total	1,424

OREGON.

	Cars.
Baker County:	
Oct.–June—	
Baker	52
Haines	5
Robinett	1
Benton County:	
Oct.–June—	
Alpine	1
Corvallis	26
Monroe	17
Summit	4
Wellsdale	1
Clackamas County:	
Aug.–May—	
Barlow	4
Beaver Creek	2
Boring	15
Canby	94
Clackamas	47
Eagle Creek	1
Estacada	1
Liberal	9
Milwaukie	4
Molalla	5
Oregon City	84
Oswego	20
Wilsonville	2
Columbia County:	
Sept.–June—	
Deer Island	2
Houlton	4
St. Helens	1
Scappoose	9
Crook County:	
Nov.–June—	
Bend	2
Redmond	9
Terrebonne	1
Douglas County:	
Oct. 27–Mar.—	
Dillard	3
Drain	1
Riddle	1
Roseburg	1
Hood River County:	
Oct.–May—	
Hood River	15
Mohrs	2
Woodworth	3
Jackson County:	
Oct.–Apr.—	
Ashland	1
Eagle Point	1
Gold Hill	1
Rogue River	1
Talent	2
Jefferson County:	
Nov. 1–May—	
Gateway	1
Madras	2
Metolius	5
Opal City	1
Klamath County:	
Feb. 19–May 2—	
Klamath Falls	3

OREGON—Continued.

	Cars.
Lane County:	
Sept.–June—	
Bear Creek	1
Coburg	26
Cottage Grove	10
Creswell	6
Eugene	53
Fall Creek	1
Goshen	2
Irving	1
Junction City	15
Lowell	12
Mohawk Junction	1
Springfield	49
Veneta	1
Walden	1
Lincoln County:	
Nov. 15–May—	
Chitwood	1
Toledo	1
Linn County:	
Sept.–May—	
Albany	44
Brownsville	4
Crabtree	16
Halsey	5
Harrisburg	12
Lebanon	46
Lyons	5
Shedd	2
Shelburn	11
West Scio	6
Malheur County:	
Nov.–Feb.—	
Nyssa	1
Ontario	1
Marion County:	
Aug.–June—	
Aumsville	5
Aurora	10
Brooks	10
Chemawa	15
Fair Grounds	2
Gervais	17
Hubbard	19
Jefferson	23
Marion	2
Mount Angel	102
Salem	60
Silverton	80
Turner	2
West Stayton	8
Woodburn	55
Multnomah County:	
Aug.–July—	
Albina	16
Brooklyn	8
Burlington	2
Corbett	57
East Portland	540
East St. Johns	1
Fairview	10
Gresham	10
Linnemann Junction	16
Montavilla	7
Pleasant Home	5
Portland	251
Troutdale	36
Polk County:	
Oct. 30–Apr.—	
Airlie	1
Dallas	4
Derry	3
Independence	5
McCoy	1
Monmouth	5
Sherman County:	
Feb. 10–19—	
Kent	6

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

OREGON—Continued.

	Cars.
Tillamook County:	
Oct.-Feb.—	
Garibaldi	1
Owens	1
Umatilla County:	
Aug.-Apr.—	
Ferndale	3
Freewater	1
Milton	1
Sunnyside	5
Union County:	
Sept.-June—	
Bacon	1
Cove	5
Elgin	12
Imbler	49
La Grande	21
Union	5
Wallowa County:	
Nov. 2-Apr.—	
Enterprise	7
Joseph	1
Wallowa	2
Wasco County:	
Aug. 30-Apr.—	
Dufur	7
Maupin	3
Mosier	1
Shaniko	1
The Dalles	4
Washington County:	
Sept.-June—	
Banks	16
Beaverton	34
Buxton	6
Cornelius	26
Dilley	1
Forest Grove	10
Gaston	14
Hillsboro	60
North Plains	20
Reedville	11
Sherwood	39
Tigard	6
Timber	2
Tualatin	18
Wilkesboro	3
Yamhill County:	
Oct.-June—	
Carlton	4
Dayton	8
Dundee	6
McMinnville	3
Newberg	9
Sheridan	21
Yamhill	1
Oreg., State total	2,644

PENNSYLVANIA.

Adams County:	
Sept. 15—	
Biglerville	1
Allegheny County:	
Sept.—	
Springvale	8
Armstrong County:	
Oct.-Nov.—	
Craigsville	3
Dayton	3
Worthington	1
Beaver County:	
Nov.—	
Beaver Falls	1
Berks County:	
Aug.-May—	
Barto	2
Hamburg	3
Joanna	16
Kempton	205
Kutztown	24

PENNSYLVANIA—Contd.

	Cars.
Berks County—Continued.	
Aug.-May—	
Leesport	5
Lenhartsville	15
Maiden Creek	14
Mertztown	2
Reading	1
Shamrock	2
Shoemakersville	5
Topton	4
Virginville	38
Bradford County:	
Oct. 1-Mar.—	
Alba	4
Canton	9
Cowley	4
Gillett	1
Grover	2
Milan	5
New Albany	5
Standing Stone	5
Towanda	6
Troy	4
Wilawana	5
Wyalusing	12
Wysox	32
Bucks County:	
Aug.-Apr.—	
Bristol	1
Buckingham	5
Churchville	25
Croydon	6
Doylestown	21
George School	3
Lahaska	16
Langhorne	4
Morrisville	87
Neshaminy Falls	2
New Hope	3
Newtown	4
Roelofs	22
Traymore	2
Trevose	1
Tullytown	99
Walbert	1
Woodbourne	3
Wycombe	47
Yardley	14
Cambria County:	
Sept.-Jan.—	
Hastings	6
Patton	19
Carbon County:	
Sept.-Mar.—	
Ashfield	1
Germans	5
Lehigh Gap	1
Lizard Creek Junction	3
Weatherly	2
Weissport	11
Center County:	
Oct.-Nov.—	
Coburn	1
Port Matilda	1
Chester County:	
Sept.-Apr.—	
Atglen	62
Avondale	7
Baker	1
Brandamore	2
Buck Run	7
Chatham	1
Coatesville	2
Elk View	21
Elverson	15
Embreeville	3
Glen Moore	1
Honey Brook	4
Kelton	30
Kennett	14
Landenberg	6
Lenape	2

PENNSYLVANIA—Contd.

	Cars.
Chester County—Continued.	
Sept.-Apr.—	
Lincoln University	7
Northbrook	2
Oxford	11
Parksburg	5
Wagontown	1
Clarion County:	
Nov.-Feb.—	
Mayport	2
Clearfield County:	
Sept.-Jan.—	
Berwindale	9
Smoke Run	3
Columbia County:	
Sept.-Apr.—	
Catawissa	55
Crawford County:	
Oct.-June—	
Cochranton	13
Conneaut Lake	1
Espyville	3
Geneva	4
Hydetown	4
Linesville	8
Meadville	1
Spartansburg	7
Titusville	5
Tryonville	5
Cumberland County:	
Oct.-Nov.—	
Mechanicsburg	1
Starners	2
Erie County:	
Sept.-Apr.—	
Albion	1
Crayton	4
Elk Creek	8
Erie	2
Fairview	5
Girard	6
Mill Village	7
North East	2
North Girard	1
Platea	1
Springfield	11
Swanville	1
Union City	3
Waterford	2
Fayette County:	
Oct. 10-26—	
Somerfield	2
Franklin County:	
Sept.-Oct. 9—	
Midvale	2
Waynesboro	2
Indiana County:	
Oct.-May—	
Cherry Tree	4
Fleming Summit	1
Hillman	1
Plumville	14
Savan	8
Shelocta	2
Jefferson County:	
Nov.-Apr.—	
Big Run	9
Brookville	2
Reynoldsville	1
Sprankle Mills	1
Lancaster County:	
July-Apr.—	
Bareville	33
Bird in Hand	8
Christiana	20
East Earl	2
Elizabethtown	3
Fairmount	43
Florin	1
Fulton House	3
Gap	14
Gordonville	2
Goshen	19

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

PENNSYLVANIA—Contd.	Cars.
Lancaster County—Continued.	
July–Apr.—	
Landisville	2
Leaman Place	9
Leola	6
Lititz	28
McCalls Ferry	8
Manheim	11
New Holland	27
New Providence	1
Quarryville	68
Rheems	2
Ronks	2
Spruce Grove	3
Stevens	3
White Oak	2
White Rock	39
Lebanon County:	
Oct.–Apr.—	
Lebanon	1
Sheridan	2
Lehigh County:	
Sept.–June—	
Alburtis	15
Allentown	4
Best	106
Centre Valley	3
Chapman	18
Emaus	6
Germansville	399
Hokendauqua	50
Lynnport	149
Macungie	57
Slatedale	8
Slatington	8
Trexlertown	54
Tripoli	76
Wanamakers	108
Zionsville	6
Luzerne County:	
Sept. 6–Nov. 3—	
Beach Haven	7
Fern Glen	1
Jeddo	1
Lycoming County:	
Oct.–Feb.—	
Roaring Branch	4
Mercer County:	
Oct.–June—	
Clarks Mills	1
Fredonia	2
Jackson Center	4
Mercer	10
Sandy Lake	3
Sharon	1
Stoneboro	4
Transfer	1
Montgomery County:	
Apr.—	
Palm	1
Northampton County:	
Sept.–May—	
Bath	7
Belfast	1
Chapman Quarries	10
Danielsville	1
East Bangor	2
Easton	1
Freemansburg	1
Jacksonville	3
Martins Creek	2
Navarro	1
Nazareth	2
Portland	3
Siegfried	10
Stockertown	6
Treichler	24
Weaversville	1
Wind Gap	4
Northumberland County:	
Nov.–Mar.—	
Dornsife	4

PENNSYLVANIA—Contd.	Cars.
Perry County:	
Nov.–Jan.—	
Millerstown	5
Philadelphia County:	
July–June—	
Philadelphia	50
Shackamaxon	2
Potter County:	
Oct.–May—	
Andrews Settlement	3
Coneville	4
Coudersport	42
Galeton	11
Genesee	34
Harrison Valley	4
Millport	2
Mills	4
New Field Junction	9
Oswayo	35
Rose Lake	2
Ulysses	8
Walton	7
West Bingham	6
Woodville	1
Schuylkill County:	
Oct.–Apr.—	
Andreas	6
Drehersville	8
Ferndale	3
Good Spring	2
Gordon	1
Millers	1
New Ringgold	20
Sittler	16
Snyders	4
Snyder County:	
Nov.–Feb.—	
Beavertown	1
Selinsgrove	1
Somerset County:	
Sept.–May.—	
Berlin	24
Boswell	35
Confluence	1
Friedens	6
Garrett	1
Gray	1
Meyersdale	1
Salisbury Junction	3
Sand Patch	3
Stoystown	2
West Salisbury	4
Sullivan County:	
Oct. 16–Nov. 29—	
Dushore	16
Susquehanna County:	
Aug. 15–Dec. 30—	
Herrick Center	4
Kingsley	1
Montrose	6
Tioga County:	
Oct. 4–Mar.—	
Lawrenceville	2
Millerton	1
Sabinsville	2
Tioga Junction	3
Wellsboro Junction	1
Venango County:	
Aug.—	
Oil City	1
Washington County:	
Sept.–Dec.—	
Burgettstown	1
Primrose	1
Washington	3
Wayne County:	
Nov. 4–16—	
Honesdale	1
Poyntelle	1

PENNSYLVANIA—Contd.	Cars.
Wyoming County:	
Oct. 22–Mar.—	
Laceyville	2
Meshoppen	1
Vosburg	1
York County:	
Aug.–Apr.—	
Bridgeton	1
Brogueville	85
Dallastown	7
Delta	1
Fawn Grove	20
Felton	44
Glatfelters	5
Glen Rock	14
Glenville	20
Hanover	1
Hanover Junction	4
Highrock	27
Hokes	5
Laurel	19
Muddy Creek Forks	23
New Freedom	22
New Park	38
Red Lion	31
Sheffer	25
Shrewsbury	2
Sinsheim	6
Smyser	6
Spring Grove	1
Stewartstown	50
Turnpike	50
Wiley	27
Woodbine	17
York	2
Pa., State total	3,819
RHODE ISLAND.	
Newport County:	
Aug. 2–Sept. 18—	
Melville	2
Providence County:	
Aug.–July—	
Auburn	1
Providence	18
Washington County:	
Sept.–Jan.—	
Slocum	36
R. I., State total	57
SOUTH CAROLINA.	
Beaufort County:	
May 15–June 30—	
Beaufort	7
Port Royal	25
Sheldon	56
Charleston County:	
May 16–June 12—	
Charleston	319
John's Island	395
Meggett	216
Yonge's Island	180
Colleton County:	
May 28–June 2—	
Green Pond	6
Georgetown County:	
May 31–June 11—	
Georgetown	4
Hampton County:	
May 20—	
Furman	1
Horry County:	
May 29–June 15—	
Aynor	5
Myrtle Beach	47
Jasper County:	
May 20–June 20—	
Ridgeland	2

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

SOUTH CAROLINA—Contd.

	Cars.
Marlboro County:	
June 1-8—	
Clio	1
S. C., State total	1,264

SOUTH DAKOTA.

	Cars.
Aurora County:	
Sept.—	
White Lake	2
Beadle County:	
Sept.-Apr.—	
Cavour	10
Hitchcock	9
Huron	24
Virgil	1
Yale	1
Brookings County:	
Sept.-Apr.—	
Aurora	12
Brookings	25
Bruce	100
Elkton	44
Sinai	9
Volga	38
White	130
Brown County:	
Oct.-June—	
Aberdeen	90
Bath	2
Claremont	35
Columbia	1
Ferney	3
Frederick	5
Groton	4
Hecla	1
Houghton	5
Huffton	11
James	2
Ordway	1
Putney	4
Randolph	1
Stratford	3
Westport	19
Warner	15
Brule County:	
Apr. 4-June 3—	
Kimball	1
Pukwana	4
Butte County:	
Sept. 9-Nov. 15—	
Belle Fourche	16
Newell	1
Clark County:	
Oct.-May—	
Bradley	7
Clark	15
Crocker	1
Elrod	8
Garden City	6
Naples	1
Raymond	4
Vienna	1
Willow Lake	17
Codington County:	
Sept.-June—	
Florence	8
Grover	19
Henry	55
Kampeska	4
Kranzburg	13
South Shore	17
Wallace	9
Watertown	48
Corson County:	
Oct. 28—	
Morristown	3
Watauga	1
Custer County:	
Oct. 20-Mar.—	
Custer	1
Pringle	3

SOUTH DAKOTA—Contd.

	Cars.
Day County:	
Aug.-May—	
Andover	1
Bristol	1
Holmquist	1
Lily	1
Pierpont	3
Waubay	4
Webster	7
Deuel County:	
Sept.-Apr.—	
Altamont	2
Astoria	15
Bemis	3
Brandt	37
Goodwin	19
Douglas County:	
Nov.-May—	
Delmont	4
Edmunds County:	
Oct.-June—	
Bowdle	20
Loyalton	2
Mina	3
Roscoe	5
Faulk County:	
Sept.-Jan.—	
Chelsea	3
Faulkton	5
Seneca	1
Grant County:	
Apr.-May—	
Albee	2
La Bolt	1
Strandburg	1
Gregory County:	
Mar. 2-June 13—	
Burke	1
Gregory	5
Hamlin County:	
Sept.-Apr.—	
Dempster	19
Estelline	52
Hazel	4
Thomas	3
Hand County:	
Sept. 22-Nov. 9—	
Miller	3
Ree Heights	2
St. Lawrence	1
Hanson County:	
Sept.—	
Farmer	1
Hughes County:	
Sept. 15-Oct. 15—	
Canning	4
Harrold	3
Hyde County:	
Oct. 28-Nov. 28—	
Highmore	3
Holabird	1
Jackson County:	
Oct. 28—	
Interior	1
Jerauld County:	
Feb. 14-June 12—	
Alpena	4
Wessington Springs	1
Kingsbury County:	
Sept.-Apr.—	
Arlington	7
Badger	12
Bancroft	3
De Smet	3
Erwin	1
Hetland	17
Lake Preston	22
Oldham	43
Lake County:	
Sept.-May—	
Chester	4
Junius	15
Madison	16

SOUTH DAKOTA—Contd.

	Cars.
Lake County—Continued.	
Sept.-May—	
Rutland	12
Wentworth	8
Winfred	2
Lawrence County:	
Sept.-May—	
Deadwood	1
Lead	1
Nemo	4
St. Onge	29
Spearfish	55
Whitewood	2
McCook County:	
Nov.-June—	
Spencer	3
McPherson County:	
Oct. 20-May—	
Eureka	1
Leola	8
Marshall County:	
Sept.-May—	
Amherst	7
Britton	14
Burch	5
Langford	23
Newark	3
Veblen	5
Minnehaha County:	
Oct.-June—	
Booge	1
Brandon	3
Ellis	2
Garretson	4
Sherman	8
Sioux Falls	29
Moody County:	
Sept.-June—	
Colman	3
Flandreau	12
Trent	2
Ward	11
Pennington County:	
Sept. 4-10—	
Rapid City	2
Potter County:	
Nov.-May—	
Hoven	1
Lebanon	15
Roberts County:	
Oct.-June—	
Ortley	4
Summit	6
Wilmot	1
Sanborn County:	
Feb. 19-June 5—	
Artesian	2
Letcher	3
Spink County:	
Sept.-Apr.—	
Brentford	5
Crandon	1
Doland	1
Mansfield	1
Mellette	4
Northville	16
Turton	6
Sully County:	
Oct. 1-Dec. 15—	
Agar	4
Tripp County:	
Sept.-Feb.—	
Winner	15
Walworth County:	
Oct.-June—	
Glenham	6
Selby	7
Yankton County:	
Oct.—	
Yankton	2
S. Dak., State total	1,622

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

TENNESSEE.	Cars.
Davidson County:	
June 17-27—	
Donelson	1
Edenwold	1
Goodletts	1
Nashville	3
Gibson County:	
July 1-14—	
Humboldt	1
Medina	3
Lincoln County:	
Sept.—	
Howell	1
Marion County:	
Aug.-Oct.—	
Jasper	5
Marshall County:	
Jan. 15-29—	
Cornersville	2
Maury County:	
June 30-July—	
Ashwood	4
Carters Creek	3
Columbia	4
Morgan County:	
Nov.-Feb.—	
Lancing	3
Sunbright	1
Sumner County:	
June—	
Hendersonville	1
Warren County:	
July 15-Aug. 22—	
McMinnville	2
White County:	
July-Nov.—	
Clifty	5
Wilson County:	
Nov.-Dec.—	
Silver Springs	2
Tenn., State total	43

TEXAS.	Cars.
Anderson County:	
July—	
Elkhart	6
Atascosa County:	
Apr. 26-May 13—	
Poteet	9
Bowie County:	
June—	
Maud	1
Cameron County:	
Mar. 24-Apr. 20—	
Brownsville	101
Elrain	6
Harlingen	3
Rancho Colorado	1
Rio Hondo	1
Santa Maria	4
San Benito	50
Camp County:	
June 7—	
Newsome	1
Cherokee County:	
May 30-July 31—	
Jacksonville	12
Colorado County:	
May 4-June 14—	
Eagle Lake	441
Eldridge	18
Matthews	5
Cooke County:	
Dec. 3—	
Gainesville	1
Dallas County:	
Dec.-May—	
Dallas	8
Garland	2

TEXAS—Continued.	Cars.
El Paso County:	
June 17-Sept. 8—	
El Paso	5
Fannin County:	
June 12-Sept. 15—	
Bonham	4
Fort Bend County:	
May 2-June 29—	
Fulshear	41
Simonton	193
Sugar Land	11
Gregg County:	
May 27-June 14—	
Gladwater	2
Harris County:	
May 23-June 30—	
Hallsville	3
Houston	9
Spring	47
Tomball	27
Harrison County:	
May-June—	
Marshall	6
Hidalgo County:	
May—	
McAllen	1
Hopkins County:	
June—	
Como	1
Houston County:	
May 19-26—	
Crockett	3
Latexo	3
Kleberg County—	
Jan. 25-Mar. 10—	
Riviera Station	9
Lamar County:	
June—	
Paris	2
Matagorda County:	
June 7-10—	
Pledger	2
Mitchell County:	
June—	
Colorado	11
Montgomery County:	
June—	
Keenan	1
Morris County:	
May 31-June 10—	
Daingerfield	8
Naples	3
Omaha	1
Navarro County:	
June 14—	
Corsicana	1
Parker County:	
June 13-30—	
Garner	2
Weatherford	11
Smith County:	
June—	
Bullard	1
Swan	4
Titus County:	
June 3-16—	
Mt. Pleasant	7
Van Zandt County:	
June—	
Edgewood	8
Wills Point	1
Washington County:	
June 9-17—	
Brenham	3
Wharton County:	
May 4-June 29—	
Bonus	19
Egypt	103
Glen Flora	58
Lane City	4
Wharton	343

TEXAS—Continued.	Cars.
Wise County:	
June 7-16—	
Boyd	3
Wood County—	
June—	
Mineola	18
Tex., State total	1,649

UTAH.	Cars.
Beaver County:	
Nov. 4—	
Milford	2
Boxelder County:	
Aug. 14-Oct. 28—	
Garland	18
Tremonton	2
Willard	9
Cache County:	
Sept. 1-Apr.—	
Cache Junction	8
Cornish	1
Lewiston	1
Smithfield	13
Trenton	13
Carbon County:	
Sept.—	
Price	10
Davis County:	
Aug. 25-Oct. 13—	
Clearfield	1
Layton	5
Iron County:	
Nov. 13—	
Modena	1
Morgan County:	
Dec.-Mar.—	
Morgan	9
Salt Lake County:	
July-June—	
Hot Springs	1
Murray	3
Riverton	1
Salt Lake City	27
Sandy	2
Sanpete County:	
Dec.-Feb.—	
Moroni	1
Mount Pleasant	1
Spring City	3
Sevier County:	
Oct. 10-Dec. 10—	
Elsinore	5
Richfield	6
Saline	14
Uinta County:	
Nov.-May—	
American	6
Utah County:	
Sept.-Mar.—	
American Fork	20
Linden	4
Payson	6
Pleasant Grove	5
Provo	12
Selman	1
Washington County:	
Oct.-Mar.—	
Midvale	1
Weber County:	
July-May—	
Ogden	97
Roy	10
Uintah	1
West Weber	1
Utah, State total	321

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

VERMONT.

	Cars.
Addison County:	
May 17–June 1—	
Bristol	43
Middlebury	1
Bennington County:	
Oct. 2–Nov. 11—	
North Pownal	2
Shaftsbury	1
Caledonia County:	
July–Apr.—	
East Hardwick	2
Groton	2
St. Johnsbury	1
Chittenden County:	
Oct.–Feb.—	
Jonesville	6
Richmond	2
Underhill	3
Essex County:	
Sept.–Feb.—	
Island Pond	4
Maidstone	10
Franklin County:	
Oct. 9–Jan.—	
East Highgate	1
Richford	1
St. Albans	4
Swanton	2
Grand Isle County:	
Aug.–May—	
Alburgh	1
Isle La Motte station	2
Lamoille County:	
Sept.–Mar.—	
Hyde Park	8
Jeffersonville	1
Johnson	4
Morrisville	21
Wolcott	12
Orange County:	
Oct. 6–Nov. 9—	
Ely	1
Randolph	6
Orleans County:	
Oct.–Mar.—	
Barton	10
Centre	1
Derby Line	15
North Troy	2
Orleans	3
Rutland County:	
July–May—	
Brandon	11
Castleton	8
Cuttingsville	2
Danby	4
East Clarendon	2
East Wallingford	9
Healdville	1
Poultney	16
Rutland	6
Wallingford	3
West Pawlet	30
West Rutland	2
Washington County:	
Sept.–Mar.—	
Barre	3
Middlesex	2
Montpelier	1
Northfield	3
Plainfield	5
Roxbury	2
Windham County:	
Sept. 1–Nov. 30—	
Jamaica	2
Newfane	2
Windsor County:	
Sept. 6–Mar.—	
Bethel	9
Chester	1
Rochester	7

VERMONT—Continued.

	Cars.
Windsor County—Contd.	
Sept. 6—Mar.—	
South Royalton	3
Stockbridge	8
Vt., State total	314

VIRGINIA.

Accomac County:	
May–Apr.—	
Belle Haven	344
Bloxom	562
Franklin City	301
Greenbush	118
Hallwood	485
Keller	501
Le Cato	197
Makemie Park	336
Mason	160
Mears	225
Melfa	548
New Church	348
Oak Hall	446
Onley	494
Painter	683
Parksley	269
Tasley	468
Augusta County:	
Aug. 19–Sept. 22—	
Harriston	1
Stuart's Draft	2
Campbell County:	
Apr. 10—	
Lynchburg	1
Elizabeth City County:	
June 25–Dec. 31—	
Hampton	1
Old Point Comfort	110
Phoebus	4
Giles County:	
Oct. 11—	
Ripplemead	1
Gloucester County:	
June 8–Nov. 21—	
Allmond	19
Claybank	29
Clements Wharf	12
Gloucester Point	63
Grayson County:	
Oct. 20—	
Galax	1
Hanover County:	
Nov. 25–Apr. 5—	
East Atlee	1
Old Church	1
Henrico County:	
June–May—	
Richmond	16
Isle of Wight County:	
June 15–Aug. 14—	
Windsor	9
James City County:	
June 13–Nov. 10—	
Diascund	6
Lightfoot	17
Norge	34
Toano	343
King William County:	
May 2–Dec. 27—	
West Point	51
Montgomery County:	
Sept. 1–Nov. 14—	
Christiansburg	6
East Radford	1
Nansemond County:	
May 15–Dec.—	
Myrtle	8
Suffolk	91
New Kent County:	
July 21—	
Lanexa	1

VIRGINIA—Continued.

	Cars.
Norfolk County:	
May 15–Dec. 22—	
Fentress	180
Hickory Ground	20
Norfolk	4,111
Northwest	62
Pinner's Point	6
Port Norfolk	1,397
Portsmouth	28
St. Brides	5
Northampton County:	
June–Apr.—	
Bay View	319
Birds Nest	343
Cape Charles	1,989
Capeville	531
Cheriton	476
Cobbs	456
Eastville	466
Exmore	672
Kendall Grove	196
Kiptopeke	271
Machipongo	698
Nassawadox	667
Plantation	397
Townsend	456
Wierwood	449
Orange County:	
Aug. 3–14—	
Gordonsville	2
Page County:	
Oct.—	
Luray	13
Shenandoah	2
Stanley	3
Patrick County:	
Sept. 1–Dec. 31—	
Stuart	10
Princess Anne County:	
June 21–Dec. 20—	
Kempsville	100
London Bridge	57
Lynnhaven	45
Princess Anne	8
Virginia Beach	11
Pulaski County:	
Aug. 31–Nov. 13—	
Draper	4
Roanoke County:	
Nov. 27–Feb. 8—	
Roanoke	1
Starkey	1
Rockbridge County:	
Nov.—	
Raphine	2
Rockingham County:	
Oct. 1–Dec. 31—	
Broadway	1
Elkton	9
Smyth County:	
Aug. 6–Sept. 27—	
Chilhowie	11
Groseclose	2
Marion	4
Seven Mile Ford	5
Sugar Grove	1
Washington County:	
Nov. 11—	
Creek Junction	1
Konnarock	1
Wythe County:	
Aug. 10–Nov. 28—	
Crockett	51
Foster Falls	3
Ivanhoe	2
Rural Retreat	50
Speedwell	9
Wytheville	2
York County:	
June 15–July 24—	
Yorktown	8

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

VIRGINIA—Continued.

	Cars.
May–Nov.—	
Occohannock River landings	1,038
May 2–Nov.—	
Piankatank River landings	68
May–Nov.—	
Potomac River landings	3
July–May—	
Rappahannock River landings	104
June 16–Aug. 8—	
York River landings	6
Eastern Shore points by boat to Crisfield, Md.	895
Va., State total	24,042

WASHINGTON.

Adams County:	
Aug.—	
Othello	7
Benton County:	
June 27–Dec. 13—	
Kennewick	21
North Prosser	1
Prosser	7
Chelan County:	
Nov.–May—	
Cashmere	1
Chelan	12
Wenatchee	1
Clarke County:	
Aug.–June—	
Barberton	14
Battle Ground	10
Camas	3
Ridgefield	12
Sifton	1
Vancouver	25
Washougal	5
Columbia County:	
Dec. 8—	
Dumas	1
Cowlitz County:	
Oct.–June—	
Castle Rock	21
Kelso	16
Olequa	2
Woodland	5
Douglas County:	
Oct.–May—	
Douglas	6
Mansfield	3
Ferry County:	
Oct.–Mar.—	
Curlew	9
Danville	1
Republic	2
Franklin County:	
Oct. 15–Mar. 18—	
Connell	2
Grant County:	
Jan. 1–June 30—	
Adrian	1
Ephrata	1
Grays Harbor County:	
Nov. 27–Apr.—	
Balch	1
Carlisle	1
King County:	
Sept.–July—	
Auburn	35
Black River	1
Duvall	2
Kent	32
Pickering	2
Seattle	125
Skykomish	4
Taylor	1
Tolt	2

WASHINGTON—Continued.

	Cars.
Kittitas County:	
Oct.–May—	
Ellensburg	3
Kittitas	27
Thrall	2
Lewis County:	
Oct.–May—	
Adna	1
Centralia	3
Chehalis	18
Galvin	1
Napavine	1
Vader	2
Lincoln County:	
Sept.–Mar.—	
Davenport	7
Odessa	1
Sprague	1
Okanogan County:	
Nov.–June—	
Brewster	8
Molson	2
Okanogan	3
Oroville	3
Pateros	3
Riverside	7
Tonasket	4
Pend Oreille County:	
June—	
Newport	1
Pierce County:	
Sept.–June—	
Dempsey	2
Orting	1
Sumner	12
Tacoma	1
Skagit County:	
Sept.–June—	
Anacortes	17
Bow	2
Burlington	34
Concrete	1
Fir	75
Hamilton	7
Hop Ranche	1
Lyman	3
Mt. Vernon	107
Rockport	8
Sedro-Wooley	1
Snohomish County:	
Sept.–May—	
Everett	15
Goldbar	1
Index	2
Marysville	17
Monroe	59
Snohomish	6
Stanwood	9
Startup	5
Sultan	9
Spokane County:	
Sept.–June—	
Cheney	1
Dale	2
Dean	17
Deer Park	16
Dishman	2
Elk	1
Fairfield	7
Greenacres	1
Hillyard	81
Latah	58
Mica	7
Millwood	1
Otis Orchards	5
Rockford	17
Spangle	1
Spokane	211
Yardley	71
Stevens County:	
Oct.–June—	
Addy	8
Chewelah	16

WASHINGTON—Continued.

	Cars.
Stevens County—Contd.	
Oct.–June—	
Colville	49
Marcus	3
Meyers Falls	20
Spring Dale	1
Thurston County:	
Nov. 30—	
Independence	1
Walla Walla County:	
July 18–Apr.—	
Attalia	1
Finch	1
Walla Walla	76
Wallula	5
Whatcom County:	
Dec.–May—	
Bellingham	2
Custer	8
Ferndale	5
Whitman County:	
July–June—	
Albion	20
Almota	2
Colfax	13
Elberton	3
Farmington	7
Garfield	8
Malden	3
Mockonema	1
Oakesdale	8
Palouse	17
Pine City	6
Pullman	2
Rosalia	34
St. John	1
Tekoa	14
Thornton	7
Uniontown	7
Winona	1
Yakima County:	
June–May—	
Academy	1
Ahtanum	21
Congdon	1
Exchange	2
Farron	2
Grandview	153
Granger	86
Harwood	16
Mabton	3
Naches	3
North Yakima	1,324
Orchard	3
Outlook	158
Quarry Spur	1
Selah	4
Sunnyside	151
Taylor	1
Toppenish	586
Wapato	5
Wesley Junction	1
Westbrook	4
Wiley City	49
Zillah	25
Wash., State total	4,338

WEST VIRGINIA.

Barbour County:	
Aug. 31–Oct. 26—	
Belington	3
Philippi	3
Greenbrier County:	
Dec. 1—	
White Sulphur	1
Hardy County:	
Oct. 17—	
McNeil	1
Jackson County:	
Oct.–Dec.	
Millwood	8

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

WEST VIRGINIA—Contd.

	Cars.
Marshall County:	
Oct.—	
Glen Easton	1
Mason County:	
Aug.-May—	
Graham	10
Letart	7
New Haven	2
Monroe County:	
Nov. 13—	
Alderson	1
Ohio County:	
July-Apr.	
Wheeling	2
Pleasants County:	
Nov. 2—	
Belmont	1
Preston County:	
Aug.—	
Albright	2
Reedsville	1
Randolph County:	
Oct.-May—	
Beverly	5
Kerens	1
Montrose	1
Summers County:	
Nov. 11—	
Sandstone	1
Wood County:	
Aug.- Dec. 9—	
Belleville	6
Parkersburg	1
Walker	1
W. Va., State total	59

WISCONSIN.

Adams County:	
Oct.-June—	
Adams	36
Brooks	58
Grand Marsh	85
Holmesville	117
Ashland County:	
Oct.-May—	
Butternut	8
High Bridge	3
Sanborne	3
Barron County:	
Sept.-June—	
Almena	24
Barron	105
Barronett	8
Cameron	20
Canton	23
Chetek	191
Comstock	2
Cumberland	7
Dallas	124
Haugen	6
Poskin Lake	26
Rice Lake	138
Turtle Lake	26
Bayfield County:	
Nov.-Apr.	
Cable	24
Grandview	1
Iron River	4
Mason	3
Brown County:	
Aug.-June—	
De Pere	2
Green Bay	24
Tremble	6
Buffalo County:	
Oct.-May—	
Cochrane	5

WISCONSIN—Continued.

Burnett County:	
Oct. 26-May—	Cars.
Danbury	15
Grantsburg	111
Siren	42
Webster	75
Calumet County:	
Oct.	
Potter	1
Chippewa County:	
Aug.-June	
Albertville	16
Bloomer	276
Boyd	10
Cadott	10
Chippewa Falls	68
Cotten	8
Eagle Point	13
New Auburn	142
Stanley	13
Clark County:	
Nov.-Apr.	
Abbotsford	1
Colby	3
Dorchester	1
Humbird	20
Thorpe	35
Columbia County:	
Oct.-June —	
Cambria	16
Doylestown	20
Fall River	4
Friesland	28
Kilbourn	99
Pardeeville	66
Portage	99
Poynette	9
Rio	13
Wyocena	40
Dane County:	
Aug.-May—	
Cross Plains	1
Madison	9
Dodge County:	
Nov.-June—	
Brownsville	4
Lomira	25
Theresa	6
Door County:	
Oct.-Dec.—	
Sturgeon Bay	15
Douglas County:	
Oct.-June—	
Bennett	2
Gordon	5
Hawthorne	2
Lake Nebagamon	3
Solon Springs	2
South Range	2
Dunn County:	
Sept.-June—	
Boyceville	35
Colfax	45
Elk Mound	24
Menomonie	3
Ridgeland	42
Wheeler	29
Eau Claire County:	
Aug.-June—	
Cleghorn	8
Eau Claire	1
Fairchild	41
Fall Creek	36
Florence County:	
Nov.-Feb.	
Florence	6
Fond du Lac County:	
Nov.-May—	
Campbellsport	53
Fond du Lac	1
Ripon	5

WISCONSIN—Continued.

Forest County:	
Sept. 23-Apr.	Cars.
Armstrong Creek	2
Cavour	2
Crandon	4
Laona Junction	2
North Crandon	70
Wabeno	5
Green Lake County:	
Nov.-June—	
Berlin	16
Dalton	2
Princeton	59
Iron County:	
Sept. 12-Nov. 27—	
Gurney	5
Mercer	6
Jackson County:	
Nov.-June—	
Alma Center	21
Black River Falls	2
Hixton	12
Jefferson County:	
May 1—	
Jefferson	1
Juneau County:	
Sept.-June—	
Camp Douglas	16
Elroy	17
Hustler	21
Lyndon	115
Mauston	167
Necedah	90
New Lisbon	27
Union Center	12
Wonewoc	110
Kenosha County:	
Oct.—	
Somers	5
Kewaunee County:	
Oct.—	
Algoma	1
La Crosse County:	
Jan. 4-May 27—	
La Crosse	9
Langlade County:	
Oct.-Mar.—	
Antigo	134
Bryant	24
Deerbrook	11
Summit Lake	2
Lincoln County:	
Oct.-June—	
Heafford Junction	4
Irma	1
Merrill	14
Tomahawk	17
Manitowoc County:	
June 3—	
Kiel	1
Marathon County:	
Oct.-May—	
Athens	10
Dancy	19
Elderon	99
Hatley	11
Kelly	25
Spencer	6
Unity	1
Wausau	13
Marinette County:	
Sept.-June—	
Amberg	30
Bagley Junction	33
Beaver	14
Coleman	31
Ellis Junction	10
Middle Inlet	3
Pembine	14
Peshtigo	40
Pound	2
Walsh	8
Wausaukee	48

TUBER CROPS—Continued.

Table 48.—WHITE POTATOES—Continued.

WISCONSIN—Continued.

	Cars.
Marquette County:	
Nov.–June—	
Endeavor	44
Glenoak	29
Montello	59
Neshkoro	104
Oxford	47
Packwankee	4
Westfield	249
Milwaukee County:	
Aug.–June—	
Milwaukee	5
Monroe County:	
Oct.–May—	
Kendalls	2
Valley Junction	1
Warren	9
Wyeville	2
Oconto County:	
Oct.–May—	
Lena	3
Mountain	5
Oconto	17
Suring	6
Oneida County:	
Sept.–Apr.—	
Hazelhurst	8
Minocqua	3
Monico	1
Pelican	6
Rhinelander	102
Starks	35
Three Lakes	39
Woodruff	10
Outagamie County:	
Oct.–Apr.—	
Appleton	2
Dale	6
Hortonville	31
Medina	16
Sugar Bush	6
Pepin County:	
Oct.–Feb.—	
Stockholm	7
Pierce County:	
Oct.–May—	
Beldenville	1
River Falls	89
Polk County—	
Sept.–May—	
Centuria	3
Clayton	2
Dresser Junction	20
Frederic	26
Luck	8
Portage County:	
Sept.–June—	
Almond	317
Amherst	456
Amherst Junction	75
Arnott	26
Bancroft	192
Custer	5
Junction City	55
Plover	50
Rosholt	62
Stevens Point	177
Stockton	121
Price County:	
Sept.–Apr.—	
Catawba	2
Fifield	1
Phillips	19
Prentice	5
Racine County:	
Oct.—	
Burlington	3
Rock County:	
Mar. 15–June 1—	
Clinton Junction	6
Janesville	1
Lima Center	1
Milton Junction	1

WISCONSIN—Continued.

	Cars.
Rusk County:	
Sept.–Apr.—	
Bruce	36
Hawkins	1
Murry	3
Strickland	3
Weyerhaeuser	3
St. Croix County:	
Aug.—	
Somerset	3
Wilson	1
Sauk County:	
Oct.–June—	
Ableman	21
Baraboo	39
La Valle	1
Merrimac	11
North Freedom	6
Prairie du Sac	1
Reedsburg	79
Sauk City	2
Sawyer County:	
Oct.–Jan.—	
Exeland	15
Hayward	31
Radisson	2
Stone Lake	17
Shawano County:	
Sept.–June—	
Birnamwood	10
Bowler	3
Green Valley	1
Lyndhurst	14
Mattoon	1
Pulaski	8
Shawano	97
Split Rock	10
Tigerton	8
Wittenberg	4
Taylor County:	
Oct.–Apr.—	
Lublin	4
Medford	6
Rib Lake	2
Stetsonville	9
Trempealeau County:	
Sept.–May—	
Blair	10
Galesville	2
Independence	1
Osseo	1
Vernon County:	
Oct.–Jan.—	
Chaseburg	5
Stoddard	7
Vilas County:	
Oct.–Dec.—	
Conover	3
Eagle River	20
Washburn County:	
Oct.–June—	
Lampson	4
Minong	14
Sarona	5
Shell Lake	3
Spooner	29
Springbrook	10
Trego	66
Washington County:	
Sept.–June—	
Allenton	16
Colgate	1
Germantown	1
Hartford	18
Jackson	12
Kewaskum	58
Richfield	7
Schleisingerville	15
South Germantown	1
West Bend	42

WISCONSIN—Continued.

	Cars.
Waukesha County:	
Oct.–Jan.—	
Dousman	3
Mukwonago	4
North Prairie	3
Waukesha	2
Waupaca County:	
Sept.–July—	
Clintonville	36
Embarrass	63
Fremont	80
Iola	339
Manawa	47
Marion	1
New London	60
Ogdensburg	52
Royalton	69
Scandinavia	184
Sheridan	187
Waupaca	456
Weyauwega	168
Waushara County:	
Sept.–June—	
Coloma	338
Hancock	301
Plainfield	139
Red Granite	145
Wautoma	360
Wild Rose	487
Winnebago County:	
July 7–Nov.—	
Larsen	4
Medina Junction	1
Oshkosh	2
Wood County:	
Oct.–May—	
Babcock	1
Grand Rapids	111
Milladore	2
Nekoosa	50
Pittsville	21
Vesper	18
Wis., State total	11,281

WYOMING.

Bighorn County:	
Oct.—	
Basin	6
Converse County:	
Oct.–Apr.—	
Lost Spring	7
Fremont County:	
Nov.–Mar.—	
Lander	8
Goshen County:	
Sept. 20–Dec. 31—	
Lingle	5
Torrington	30
Laramie County:	
Nov. 6—	
Egbert	1
Niobrara County:	
Aug.–May—	
Manville	18
Van Tassell	41
Park County:	
Oct.–Apr.—	
Cody	14
Garland	5
Powell	22
Washakie County:	
Sept. 1–Dec. 31—	
Worland	12
Weston County:	
Oct.–June—	
Newcastle	1
Upton	1
Wyo., State total	171

TUBER CROPS—Continued.

Table 49.—SWEET POTATOES.

ALABAMA.

	Cars.
Baldwin County:	
Aug. 1–June 7—	
Bay Minette	58
Foley	129
Hurricane	13
Loxley	21
Silverhill	9
Covington County:	
Oct. 1–Dec. 31—	
Andalusia	4
Cullman County:	
Aug. 15–June 1—	
Cullman	145
Houston County:	
Aug. 15—	
Columbia	1
Lee County:	
Aug. 11—	
Opelika	1
Mobile County:	
Jan. 1–Mar. 1—	
Grand Bay	3
Irvington	1
Theodore	14
Sumter County:	
Aug. 1–June 7—	
York	20
Ala., State total	419

ARKANSAS.

Ashley County:	
Nov. 5–Dec. 31—	
Hamburg	7
Montrose	2
Benton County:	
May 24–25—	
Rogers	2
Bradley County:	
Dec. 12–20—	
Warren	4
Columbia County:	
Aug. 15–Jan.—	
Emerson	6
McNeill	25
Magnolia	112
Waldo	8
Crawford County:	
Aug. 1–Dec. 27—	
Alma	11
Dallas County:	
Aug. 1–Dec. 27—	
Dalark	2
Fordyce	12
Drew County:	
Sept. 1–Dec. 10—	
Monticello	11
Franklin County:	
Aug. 1–Dec. 27—	
Branch	17
Ozark	7
Howard County:	
Feb. 1–10—	
Nashville	2
Jackson County:	
Jan. 8–Feb. 16—	
Auvergne	1
Grubbs	3
Lafayette County:	
Oct. 3–Nov. 14—	
Buckner	3
Stamps	1
Logan County:	
Aug. 1–Apr. 6—	
Booneville	17
Paris	4
Lonoke County:	
Feb. 24—	
Carlisle	1

ARKANSAS—Continued.

	Cars.
Miller County:	
Oct. 1–Dec. 10—	
Texarkana	20
Monroe County:	
Aug. 4–Mar. 16—	
Clarendon	1
Holly Grove	3
Keevil	13
Ouachita County:	
Oct. 1–Dec. 10—	
Bearden	2
Pope County:	
Sept. 1–May 6—	
Atkins	3
London	15
Russellville	32
Pulaski County:	
Feb. 2–Mar. 28—	
Little Rock	6
St. Francis County:	
Oct. 1–Feb. 24—	
Forest City	2
Sebastian County:	
Aug. 1–Jan. 12—	
Fort Smith	22
Ursula	3
Union County:	
Oct. 1–Dec. 10—	
El Dorado	3
White County:	
Oct. 1–Feb. 24—	
Judsonia	9
Yell County:	
May 1–6—	
Dardanelle	21
Ark., State total	413

CALIFORNIA.

Madera County:	
Jan. 15—	
Chowchilla	10
Merced County:	
Aug. 4–Mar. 24—	
Atwater	217
Livingston	79
Merced	6
Sacramento County:	
Nov. 18—	
Sacramento	1
San Francisco County:	
Sept. 2–Oct. 5—	
San Francisco	4
San Joaquin County:	
Oct. 9–Nov. 6—	
Manteca	1
Stockton	1
Santa Clara County:	
Sept. 6–Dec. 1—	
San Jose	2
Stanislaus County:	
Aug. 9–Feb. 18—	
Denair	1
Gilman	3
Hughson	4
Keyes	138
Turlock	124
Cal., State total	591

COLORADO.

Mesa County:	
Nov. 24–Dec. 20—	
Fruita	8
Colo., State total	8

DELAWARE.

	Cars.
Kent County:	
Oct. 25–Jan.—	
Harrington	1
Houston	75
Viola	1
Sussex County:	
July 1–May 4—	
Cannon	13
Delmar	340
Frankford	6
Laurel	912
Lincoln City	100
Milford	38
Millsboro	11
Nassau	4
Seaford	277
Del., State total	1,778

FLORIDA.

Alachua County:	
Mar. 17–May 4—	
Waldo	2
Baker County:	
Dec. 5–12—	
Baxter	2
Calhoun County:	
Mar. 17–May 4—	
Altha	2
Escambia County:	
Aug. 1—	
Molino	1
Holmes County:	
Aug. 17—	
Bonifay	1
JacksonCounty:	
Aug. 17–Dec. 31—	
Marianna	6
Marion County:	
Mar. 17–May 4—	
Irvine	8
Nassau County:	
Dec. 5–Feb. 2—	
Callahan	17
Hilliard	25
Fla., State total	64

GEORGIA.

Appling County:	
Oct.—	
Baxley	4
Brooks County:	
Nov. 25–Dec. 18—	
Quitman	6
Charlton County:	
Oct. 10–Dec. 31—	
Folkston	21
St. George	5
Winokur	2
Decatur County:	
Dec. 9—	
Amsterdam	1
Early County:	
Nov. 4—	
Bilton	1
Grady County:	
Sept. 3–June 18—	
Cairo	18
Pierce County:	
Sept. 3–June 18—	
Blackshear	51
Bristol	3
Hoboken	4
Patterson	18
Thomas County:	
Sept. 3–May 9—	
Coolidge	1
Meigs	2

TUBER CROPS—Continued.

Table 49.—SWEET POTATOES—Continued.

GEORGIA—Continued.

	Cars.
Tift County:	
Nov. 22–June 18—	
Chula	1
Omega	1
Tifton	1
Wayne County:	
Sept. 3–June 18—	
Hickox	3
Screven	15
Waynesville	1
Ga., State total	159

ILLINOIS.

Cook County:	
Aug. 23–Jan. 18—	
Chicago	4
Jackson County:	
Oct. 4–May 8—	
Makanda	41
Pomona	10
Union County:	
Nov. 1–May 1—	
Alto Pass	23
Anna	27
Cobden	176
Ill., State total	281

INDIANA.

Whitley County:	
Dec. 6—	
Collins	1
Ind., State total	1

IOWA.

Cerro Gordo County:	
Nov. 7—	
Mason City	1
Lee County:	
Oct. 18—	
Viele	2
Muscatine County:	
Sept. 28–Oct. 3—	
Fruitland	3
Iowa, State total	6

KANSAS.

Douglas County:	
Nov. 2—	
Lawrence	1
Pottawatomie County:	
Nov. 30–Jan. 16—	
St. George	1
Wamego	7
Riley County:	
Dec.—	
Manhattan	1
Kans., State total	10

KENTUCKY.

Graves County:	
Mar. 7—	
Mayfield	1
Jefferson County:	
Oct. 3—	
Louisville	1
McCracken County:	
July 21–Feb. 28—	
Paducah	4
Ky., State total	6

LOUISIANA.

	Cars.
Assumption Parish:	
Mar. 18—	
Napoleonville	1
Beauregard Parish:	
Oct. 14—	
Carson	1
Bienville Parish:	
Sept. 15–Dec. 9—	
Bienville	3
Castor	1
East Baton Rouge Parish:	
Apr. 7–Dec. 23—	
Bonn	2
Bullion	5
East Feliciana Parish:	
Apr. 7–Dec. 23—	
Ethel	7
Iberia Parish:	
Apr. 7–Dec. 23—	
Loreauville	2
New Iberia	6
Lafayette Parish:	
Aug.–June 16—	
Carencro	7
Lafayette	5
Loes	7
Lincoln Parish:	
Feb.–Mar.—	
Ruston	3
Orleans Parish:	
Nov. 28—	
New Orleans	1
Ouachita Parish:	
Oct. 15–Feb. 21—	
Monroe	17
Rapides Parish:	
July 2–Jan. 6—	
Alexandria	27
Cheneyville	81
Lamorie	2
Tioga	2
Richland Parish:	
Oct. 27—	
Archibald	1
St. Charles Parish:	
Jan. 1–June 23—	
Destrehan	3
St. Helena Parish:	
Feb. 25–Apr. 18—	
Freiler	2
St. John the Baptist Parish:	
Jan. 23–June 22—	
Montegut	2
St. Landry Parish:	
Aug. 23–Feb.—	
Arnaudville	77
Melville	1
Opelousas	9
Sunset	40
Tangipahoa Parish:	
Nov. 24–Dec. 1—	
Kents Mill	2
Vermilion Parish:	
Jan.–Feb.—	
Abbeville	2
Vernon Parish:	
Oct. 28–Nov. 2—	
Rose Line	2
Washington Parish:	
Dec. 20—	
Warnerton	1
Webster Parish:	
Aug.—	
Sibley	1
Yellow Line	1
West Feliciana Parish:	
July 9–24—	
Bayou Sara	143
La., State total	467

MARYLAND.

	Cars.
Baltimore City:	
Aug. 15–June 17—	
Baltimore	237
Caroline County:	
Sept.–Dec. 31—	
Henderson	13
Dorchester County:	
Sept. 1–Dec. 31—	
East New Market	10
Hurlock	2
Queen Annes County:	
Nov.–May—	
Love Point	4
Somerset County:	
Aug. 1–Nov. 30—	
Costen	44
Crisfield (see Va.).	
Eden	1
Loretto	3
Princess Anne	6
Talbot County:	
Nov.–May—	
Claiborne	6
Wicomico County:	
July 15–Dec. 31—	
Byrds	21
Fruitland	32
Fulton	9
Rockawalking	10
Salisbury	128
Worcester County:	
July 15–Dec. 31—	
Beaverdam	89
Girdletree	53
Hursley	7
Pocomoke	164
Showell	6
Snow Hill	10
May—	
Chester River landings.	1
Oct.–May—	
Choptank River landings	2
Sept.–May—	
Nanticoke River landings	13
Aug.	
Patuxent River landings	3
Aug. 24–Nov.—	
Pocomoke River landings	317
May—	
Potomac River landings	1
Oct.–May—	
Wicomico River landings	4
Md., State total	1,196

MISSISSIPPI.

Chickasaw County:	
Dec. 27—	
Houston	1
Claiborne County:	
July 1—	
Carlisle	1
Clarke County:	
Mar. 11–Apr. 20—	
Quitman	4
Covington County:	
Apr. 14–May 25—	
Arbo	5
Collins	18
Mt. Olive	7
Sanford	2
Forrest County:	
Apr. 5–May 5—	
Fruitland Park	8

TUBER CROPS—Continued.

Table 49.—SWEET POTATOES—Continued.

MISSISSIPPI—Continued.

	Cars.
George County:	
Aug.-Apr.—	
Evanston	3
Lucedale	7
Harrison County:	
May 13-18—	
Bond	1
Gulfport	1
Jefferson Davis County:	
May 8-30—	
Bassfeld	1
Prentiss	23
Lamar County:	
Aug.-Oct.—	
Sumrall	8
Lauderdale County:	
Sept.-Mar.—	
Kewanee	3
Russell	3
Lawrence County:	
Oct. 28-Nov. 15—	
Arm	1
Silver Creek	1
Lincoln County:	
Sept. 8-30—	
Brookhaven	2
Madison County:	
Oct. 19-23—	
Canton	2
Madison	7
Marion County:	
Oct. 22-Dec. 1—	
Columbia	5
Pearl River County:	
Nov.-Feb.—	
Carriere	4
McNeill	3
Picayune	3
Prentiss County:	
Mar. 1-19—	
Booneville	2
Simpson County:	
Nov.-May—	
Mendenhall	3
Walthall County:	
Jan. 6—	
Knoxo	1
Miss., State total	130

MISSOURI.

Dunklin County:	
Apr. 15—	
Kennett	1
Jackson County:	
Aug. 25—	
Kansas City	1
St. Louis City:	
Dec. 7—	
St. Louis	1
Mo., State total	3

NEW JERSEY.

Atlantic County:	
Nov.-Feb.—	
Cologne	16
Landisville	200
Richland	30
Wheat Road	30
Cumberland County:	
Sept.-May—	
Cedarville	2
Fairton	1
Leesburg	1
Rosenhayn	50
South Vineland	20
Vineland	43

NEW JERSEY—Continued.

	Cars.
Gloucester County:	
Aug.-June—	
Aura	8
Clarksboro	43
Harrisonville	3
Mickleton	8
Mullica Hill	66
Richwood	14
Swedesboro	793
Woodbury	12
N. J., State total	1,536

NEW MEXICO.

Roosevelt County:	
Nov. 18-Dec. 14—	
Portales	2
N. Mex., State total	2

NEW YORK.

New York County:	
Oct. 2—	
New York	4
Orange County:	
Aug. 6-Sept. 15—	
New Hampton	2
N. Y., State total	6

NORTH CAROLINA.

Beaufort County:	
Sept.-Jan.—	
Edward	25
Carteret County:	
Feb. 7-Apr. 9—	
Newport	5
Catawba County:	
Apr. 28-June 14—	
Claremont	1
Conover	2
Hickory	5
Newton	3
Columbus County:	
May 18-24—	
Mt. Tabor	1
Craven County:	
July-Aug.—	
Newbern	225
Currituck County:	
July 18-Aug. 26—	
Peninsula shipments via Elizabeth City	407
Pamlico County:	
July-June—	
Oriental	12
Vandemere	26
Pasquotank County:	
Elizabeth City (see Currituck County).	
N. C., State total	712

OHIO.

Franklin County:	
Dec.—	
Columbus	1
Portage County:	
Oct. 5—	
Ravenna	1
Wayne County:	
Nov. 2—	
Creston	1
Ohio, State total	3

OKLAHOMA.

	Cars.
Kingfisher County:	
Oct. 20—	
Kingfisher	1
McClain County:	
Oct. 9—	
Purcell	1
Muskogee County:	
July 13—	
Fort Gibson	1
Okfuskee County:	
May 7-22—	
Castle	3
Sequoyah County:	
Nov.—	
Hanson	1
Okla., State total	7

OREGON.

Benton County:	
Nov. 2-7—	
Corvallis	3
Multnomah County:	
Oct. 6-Nov. 15—	
Portland	10
Oreg., State total	13

PENNSYLVANIA.

Philadelphia County:	
Aug. 15-Oct. 31—	
Philadelphia	12
Pa., State total	12

TENNESSEE.

Carroll County:	
Dec.-Jan.—	
Huntingdon	1
McKenzie	38
Trezevant	9
Gibson County:	
Sept.—	
Milan	1
Rutherford	1
Henry County:	
Sept. 9-Dec. 31—	
Paris	16
Tipton County:	
Nov. 10-Dec. 28—	
Covington	6
Weakley County:	
Sept.-May 17—	
Gleason	8
	9
Tenn., State total	170

TEXAS.

Anderson County:	
Oct. 20—	
Palestine	1
Angelina County:	
Oct. 2-Dec. 30—	
Zavalla	5
Atascosa County:	
Sept.—	
Poteet	2
Bowie County:	
Aug.-May—	
Texarkana	4
Brazoria County:	
Nov. 6-Dec. 6—	
East Columbia	1
Sweeny	10
Callahan County:	
Oct. 1-Dec. 7—	
Clyde	28

TUBER CROPS—Continued.

Table 49.—SWEET POTATOES—Continued.

TEXAS—Continued.

	Cars.
Camp County:	
Aug.—	
Newsome	1
Pittsburg	3
Cass County:	
Nov. 27—	
Queen City	1
Chambers County:	
Dec. 23—	
Stowell	1
Cherokee County:	
Oct. 8–Dec. 23—	
Craft	2
Gallatin	3
Jacksonville	2
Comanche County:	
Feb. 23–Mar. 10—	
Comanche	2
Eastland County:	
Sept.—	
Carbon	1
Erath County:	
Sept.—	
Dublin	4
Fannin County:	
Oct. 1–Dec. 30—	
Bonham	20
Ravenna	3
Frio County:	
Jan. 1–Mar. 31—	
Pearsall	14
Gregg County:	
Sept. 1–May—	
Longview	108
Longview Junction	25
Hardin County:	
Nov.–Feb. 2—	
Silsbee	4
Harris County:	
Aug. 10–Mar. 14—	
Houston	8
Hufsmith	24
Katy	5
Spring	97
Tomball	11
Harrison County:	
Feb. 29—	
Harleton	1
Marshall	5
Henderson County:	
Nov. 21—	
Athens	1
Hopkins County:	
Aug.–Mar.—	
Como	11
Pickton	3
Sulphur Springs	23
Houston County:	
Nov.–May—	
Crockett	6
Jasper County:	
Sept.–Mar.—	
Buna	14
Kirbyville	7
Jefferson County:	
Oct. 1—	
Hamshire	2
Leon County:	
Oct. 28–Nov. 4—	
Flynn	2

TEXAS—Continued.

	Cars.
Liberty County:	
Oct. 14—	
Hightower	1
Limestone County:	
Nov. 11—	
Fallon	1
Matagorda County:	
Oct. 6—	
Bay City	1
Morris County:	
June 1–18—	
Naples	2
Polk County:	
Dec.–Mar.—	
Leggett	3
Rains County:	
Sept. 29–Nov. 7—	
Emory	4
Smith County:	
Sept. 19–Dec. 28—	
Swan	6
Troup	9
Trinity County:	
Sept. 8–Mar. 10—	
Groveton	2
Tyler County:	
Sept. 25–Dec. 30—	
Warren	3
Van Zandt County:	
Oct. 15–Nov. 31—	
Edgewood	8
Waller County:	
Sept.—	
Waller	1
Wharton County:	
June 14–Oct. 19—	
Glen Flora	3
Lane City	3
Wharton	20
Wise County:	
Nov. 17—	
Chico	1
Wood County:	
Oct. 14–Nov. 18—	
Alba	4
Winnsboro	16
Tex., State total	553

VIRGINIA.

	Cars.
Accomac County:	
Aug.–Jan.—	
Belle Haven	173
Bloxom	531
Franklin City	60
Greenbush	253
Hallwood	161
Keller	453
Le Cato	125
Makemie Park	81
Mason	248
Mears	30
Melfa	423
New Church	71
Oak Hall	171
Onley	439
Painter	462
Parksley	515
Tasley	579

VIRGINIA—Continued.

	Cars.
Augusta County:	
Aug. 1–Oct. 12—	
Spottswood	2
James City County:	
Aug. 21–Sept. 26—	
Diascund	2
Toano	1
Norfolk County:	
Aug.–June—	
Fentress	10
Norfolk	368
Port Norfolk	133
South Norfolk	4
Northampton County:	
Aug.–Mar.—	
Bay View	20
Birds Nest	69
Cape Charles	46
Capeville	57
Cheriton	35
Cobbs	19
Eastville	28
Exmore	265
Kendall Grove	18
Kiptopeke	24
Machipongo	105
Nassawadox	213
Plantation	34
Townsend	39
Wierwood	37
Princess Anne County:	
Oct. 6–Nov. 18—	
Kempville	1
Lynnhaven	3
Roanoke County:	
Nov.–Jan.—	
East Roanoke	18
July–Nov. 24—	
Occohannock River landings	694
Sept.–Nov.—	
Piankatank River landings	1
Oct.—	
Potomac River landings	1
July 18–Nov.—	
Rappahannock River landings	31
Aug. 1–Sept. 26—	
Eastern Shore points by boat to Crisfield, Md.	94
Va., State total	7,147

WASHINGTON.

	Cars.
Snohomish County:	
Sept. 28–Oct. 2—	
Everett	1
Yakima County:	
Nov. 7—	
North Yakima	1
Wash., State total	2

BULB CROPS.

Table 50.—GARLIC.

CALIFORNIA.

	Cars.
Alameda County:	
Sept. 23–Dec. 20—	
Centerville	5
Decoto	1
Niles	14
Oakland	2
Los Angeles County:	
June 8—	
Gardena	1
Orange County:	
Oct. 6—	
Santa Ana	1
Sacramento County:	
Oct. 20–Nov. 17—	
Sacramento	2
San Francisco County:	
Jan. 15–Oct. 11—	
San Francisco	4
Cal., State total	30

LOUISIANA.

	Cars.
Ascension Parish:	
July 12—	
McCall	1
Avoyelles Parish:	
June 17—	
Evergreen	1
East Baton Rouge Parish:	
May 17—	
Baton Rouge	2
Iberville Parish:	
June 5–Oct. 10—	
Grosse Tete	1
Maringouin	1
Plaquemine	1
Lafourche Parish:	
May 31–June 31—	
Thibodaux	1
Orleans Parish:	
May 23—Oct. 13—	
New Orleans	20
St. Charles Parish:	
June 23—	
Destrehan	1

LOUISIANA—Continued.

	Cars.
St. John the Baptist Parish:	
June—	
Montegut	1
St. Mary Parish:	
May 13—	
Morgan City	1
La., State total	31

NEW YORK.

New York County:	
Nov. 17—	
New York	1
N. Y., State total	1

OREGON.

Umatilla County:	
Nov. 13—	
Freewater	1
Oreg., State total	1

Table 51.—ONIONS.

ALABAMA.

	Cars.
Mobile County:	
June 5–18—	
Theodore	3
Ala., State total	3

ARKANSAS.

Crittenden County:	
Aug. 2—	
Earle	2
Little River County:	
July 27—	
Ogden	1
Sebastian County:	
Nov. 3–Dec. 5—	
Fort Smith	3
Ark., State total	6

CALIFORNIA.

Contra Costa County:	
Aug.–Mar.—	
Antioch	33
Orwood	27
Fresno County:	
June 8–Nov. 28—	
Blossoma	2
Fresno	5
Minkler	3
Sanger	2
Imperial County:	
Apr. 10–July 1—	
Brawley	53
Calipatria	2
Imperial	14
Rockwood	1
Kern County:	
June 19–July 7—	
Bakersfield	3
Los Angeles County:	
June–Mar.—	
Airville	2
Cienega	1
Los Angeles	14
Monrovia	1
Puenta	3
Rivera	6
Van Nuys	1
Watts	3
Monterey County:	
Oct. 11–Dec. 13—	
Salinas	4
Riverside County:	
Apr. 15–June 3—	
Coachella	82
Thermal	166

CALIFORNIA—Continued.

	Cars.
Sacramento County:	
June 28–Dec. 16—	
Freeport	1
Hood	5
Sacramento	67
San Benito County:	
Sept. 29–Oct. 10—	
Aromas	1
Hollister	1
San Francisco County:	
Jan. 6–Dec. 30—	
San Francisco	167
San Joaquin County:	
June–Mar.—	
Holt	8
Middle River	30
Nilegarden	2
Stockton	1,375
San Luis Obispo County:	
Oct.–Feb.—	
Oceano	4
San Luis Obispo	1
Santa Barbara County:	
Oct.–May—	
Gaudalupe	25
Lompoc	64
Lompoc Junction	16
Santa Barbara	1
Santa Clara County:	
Sept. 28—	
Gilroy	1
Santa Cruz County:	
Nov.—	
Watsonville	2
Stanislaus County:	
June 16—	
Modesto	1
Tulare County:	
July—	
Sultana	1
Cal., State total	2,201

COLORADO.

Adams County:	
Jan. 28—	
Hazeltine	1
Arapahoe County:	
Sept. 7–Nov. 22—	
Englewood	1
Littleton	14
Delta County:	
Oct. 1–Nov. 30—	
Austin	8

COLORADO—Continued.

	Cars.
Denver County:	
Sept. 14–Feb.—	
Denver	19
Larimer County:	
Oct. 7–Jan.—	
Fort Collins	3
Timnath	1
Montrose County:	
Sept. 19–Feb. 16—	
Montrose	19
Olathe	222
Sedgwick County:	
Jan. 8–10—	
Julesburg	2
Weld County:	
Sept.–Apr.—	
Ault	15
Cloverly	1
Eaton	5
Galeton	1
Greeley	48
Ione	1
Kersey	13
Lucerne	10
Severance	2
Wattenberg	5
Windsor	3
Colo., State total	394

CONNECTICUT.

Hartford County:	
Nov. 1—	
East Windsor	1
New Haven County:	
Nov.—	
Milford	6
Conn., State total	7

FLORIDA.

Alachua County:	
May 23—	
Archer	1
Fla., State total	1

GEORGIA.

Chatham County:	
May 17–Aug.—	
Savannah	8
Ga., State total	8

BULB CROPS—Continued.

Table 51.—ONIONS—Continued.

	Cars.
IDAHO.	
Ada County:	
Oct.-Jan.—	
Boise	11
Canyon County:	
Sept. 29-Nov. 11—	
Fruitland	7
Parma	1
Wanpa	2
Minidoka County:	
Dec. 17—	
Heyburn	1
Shoshone County:	
Oct. 24—	
Wallace	1
Twin Falls County:	
Oct. 9-Jan.—	
Filer	8
Twin Falls	23
Idaho, State total	57
ILLINOIS.	
Boone County:	
Feb. 11-24—	
Belvidere	5
Cook County:	
June-Mar.—	
Avondale	5
Bernice	15
Chicago	42
Dolton	90
Dunning	7
Evergreen Park	2
Glenview	1
Globe	1
Jefferson Park	30
Lansing	55
Melrose Park	3
Morton Grove	46
Norwood Park	18
Oak Glen	4
Orchard Place	12
Riverdale	55
South Holland	133
Thornton Junction	9
Kankakee County:	
Oct.-Jan.—	
Momence	4
Wilbert	45
Rock Island County:	
July 18-Nov. 11—	
Hampton	6
Joslin	1
Port Byron	2
Rapids City	4
St. Clair County:	
May 18-Aug. 15—	
East St. Louis	7
Union County:	
May—	
Anna	1
Dongola	3
Vermilion County:	
Oct.—	
Danville	1
Whiteside County:	
Sept. 12-23—	
Fulton	3
Will County:	
Oct.-Jan.—	
Joliet	6
Ill., State total	616
INDIANA	
Clark County:	
July 6-15—	
Jeffersonville	8
INDIANA—Continued.	
Dekalb County:	
Aug.-Jan.—	
Auburn	55
Butler	33
Garrett	10
New Era	6
Summit	3
Waterloo	2
Elkhart County:	
Sept.-Jan.—	
Foraker	2
Napanee	54
Fulton County—	
Aug. 23-Oct. 25—	
Akron	13
Grant County:	
Aug.—	
Marion	1
Jasper County:	
Oct.-Feb.—	
De Motte	2
Rensselaer	13
Kosciusko County:	
Sept.-Jan.—	
Atwood	2
Etna Green	7
Leesburg	5
Milford	19
Lagrange County:	
Oct. 5-7—	
South Milford	2
Stroh	5
Lake County:	
Sept. 30-Oct. 10—	
Highlands	6
Schererville	4
Laporte County:	
Sept.-Apr.—	
Hanna	4
Mill Creek	2
Stillwell	22
Union Center	2
Marshall County:	
July-Mar.—	
Bourbon	5
Bremen	7
Culver	7
Tyner	10
Newton County:	
Oct.—	
Enos	4
Noble County:	
Aug.-Feb.—	
Kendallville	97
Kimmell	154
La Otto	13
Wawaka	5
Porter County:	
Oct. 4—	
Coburg	1
Pulaski County:	
Aug.—	
Monterey	4
St. Joseph County:	
Sept.-Nov.—	
Garden City	1
Lakeville	1
New Carlisle	3
North Liberty	11
South Bend	20
Walkerton	18
Starke County:	
Sept.-Feb.—	
Hamlet	25
Knox	46
North Judson	4
Ober	2
Steuben County:	
Aug.-Mar.—	
Ashley Hudson	51
Fremont	2
Helmer	21
Pleasant Lake	4
INDIANA—Continued.	
Sullivan County:	
Oct. 1-15—	
Carlisle	2
Whitley County:	
Oct.-Apr.—	
Churubusco	167
Collins	145
Columbia City	47
Larwill	2
Ind., State total	1,161
IOWA.	
Cerro Gordo County:	
Sept.—	
Clear Lake	14
Clinton County:	
Sept. 25-Oct. 5—	
Delmar Junction	1
Teed's Grove	1
Hardin County:	
Oct. 6—	
Lawn Hill	1
Harrison County:	
Sept. 25-Oct. 6—	
California Junction	16
Modale	9
Henry County:	
Aug. 26—	
Wayne	1
Iowa County:	
July 23-Sept. 15—	
Amana	11
Homestead	3
South Amana	9
Mitchell County:	
Aug.-Nov. 14—	
Carpenter	2
Mitchell	24
Osage	11
Otranto	8
St. Ansgar	49
Stacyville	2
Toeterville	1
Muscatine County:	
Aug.—	
Nichols	2
West Liberty	1
Osceola County:	
Sept. 28—	
Harris	3
Polk County:	
Oct. 28-Dec. 9—	
Clive	1
Des Moines	1
Scott County:	
July-May—	
Bettendorf	15
Blue Grass	1
Davenport	45
Dixon	15
Le Claire	1
Pleasant Valley	176
Story County:	
Mar. 4-16—	
Nevada	2
Woodbury County:	
Sept. 25-Oct. 23—	
Sergeant Bluff	8
Iowa, State total	434
KANSAS.	
Douglas County:	
Feb. 5—	
Lawrence	1
Montgomery County:	
Sept. 6—	
Coffeyville	1
Saline County:	
Mar. 10-21—	
Salina	16

BULB CROPS—Continued.

Table 51.—ONIONS—Continued.

KANSAS—Continued.

	Cars.
Shawnee County:	
Aug.-Jan.—	
Topeka	21
Kans., State total	39

KENTUCKY.

Jefferson County:	
June-Apr.—	
Anchorage	6
Buechel	43
Jeffersontown	20
Louisville	196
St. Matthews	52
Ky., State total	317

LOUISIANA.

Assumption Parish:	
May 20-27—	
Labadieville	2
East Baton Rouge Parish:	
May 20-June 9—	
Baton Rouge	6
Iberia Parish:	
May 17-June 29—	
New Iberia	3
Rosedale	1
Iberville Parish:	
May 16-June 7—	
Bayou Goula	2
Grosse Tete	9
Maringouin	8
Plaquemine	4
Lafourche Parish:	
May 15-July 24—	
Lafourche	12
Lockport	103
Thibodaux	2
Orleans Parish:	
Apr. 20-Mar.—	
New Orleans	319
Pointe Coupee Parish:	
May 16-20—	
New Roads	5
Rapides Parish:	
May 26—	
Alexandria	1
St. Marys Parish:	
June 17—	
Boeuf	1
Terrebonne Parish:	
May 16-July 9—	
Houma	6
Schriever	1
West Baton Rouge Parish:	
May 25-June 6—	
Erwinville	12
La., State total	497

MARYLAND.

Baltimore City:	
Apr.-Feb.—	
Baltimore	73
Carroll County:	
July-Dec.—	
Melrose	3
Westminster	22
Somerset County:	
June 26-Aug. 10—	
Crisfield (see Va.)	
June-July—	
Pocomoke River landings	45
June-July—	
Potomac River landings	2
Md., State total	145

MASSACHUSETTS.

	Cars.
Essex County:	
Oct. 13-Nov. 25—	
Lawrence	2
Franklin County:	
July 29-Apr. 5—	
Deerfield	43
East Deerfield	4
Greenfield	7
Millers Falls	1
Montague	54
Mount Hermon	13
South Deerfield	1,113
Whately	156
Hampshire County:	
July 27-Apr.—	
Amherst	199
Cushman	1
Hadley	460
Hatfield	500
Northampton	92
North Hatfield	553
Norwottuck	2
Middlesex County:	
Nov. 2—	
Marlboro	1
Suffolk County:	
July 6-Dec. 26—	
Boston	9
Mass., State total	3,210

MICHIGAN.

Allegan County:	
Oct.-Jan.—	
Allegan	9
Bradley	1
Bravo	1
Dorr	15
Hamilton	2
Martin	47
Moline	7
Pearle	2
Shelbyville	24
Wayland	13
Barry County:	
Sept. 13-Jan.—	
Doster	56
Bay County:	
Oct. 3—	
Bangor	1
Berrien County:	
Sept.-Nov. 3—	
Baroda	1
Galien	7
Niles	8
Branch County:	
Oct.-Dec.—	
Union City	10
Cass County:	
Oct.—	
Glenwood	10
Huron County:	
Jan. 31—	
Elkton	1
Jackson County:	
Jan. 24—	
Jackson	1
Kalamazoo County:	
Oct.—	
Williams	3
Kent County:	
Sept.-Jan.—	
Byron Center	25
Cedar Springs	4
Grand Rapids	1
Grant	6
Lowell	5
Lenawee County:	
Aug.-Jan.—	
Cadmus	1
Ennis	7
Rollin	17
Tecumseh	1

MICHIGAN—Continued.

	Cars.
Oakland County:	
Aug.	
Bay City	1
Ottawa County:	
Oct.-Mar.	
Vriesland	51
West Olive	1
Zeeland	14
Saginaw County:	
Aug.-Nov. 28—	
Saginaw	3
Van Buren County:	
Sept.-Nov.—	
Decatur	31
McDonald	3
Mentha	1
Washtenaw County:	
Sept. 16-Feb. 23—	
Chelsea	2
Manchester	5
Pittsfield Junction	19
Mich., State total	417

MINNESOTA.

Anoka County:	
Aug.—	
Twin City Stock Yards	1
Blue Earth County:	
Oct. 2-3—	
Good Thunder	2
Clay County:	
June—	
Moorhead	1
Dakota County:	
Aug. 30-Dec. 31—	
Lakeville	3
Mendota	97
Nicols	12
Rich Valley	1
Rosemount	12
Dodge County:	
Sept.-Dec.—	
Dodge Center	32
Freeborn County:	
Sept.—	
Albert Lea	1
Goodhue County:	
Oct. 6-7—	
Kenyon	3
Hennepin County:	
Sept.-June—	
Camden Place	33
Hamel	4
Loretto	2
Minneapolis	62
Minnehaha	16
Osseo	1
Robbinsdale	1
Ramsey County:	
Sept.-Mar.—	
Minnesota Transfer	22
St. Paul	5
Scott County:	
Sept. 23-Oct. 24—	
Savage	11
Steele County:	
Oct. 4—	
Owatonna	1
Wabasha County:	
Sept. 18-Feb. 14—	
Elgin	2
Kellogg	29
Mazeppa	2
Plainview	84
Wabasha	5
Washington County:	
Nov.—	
Afton	6
Langdon	1

BULB CROPS—Continued.

Table 51.—ONIONS—Continued.

MINNESOTA—Continued.

	Cars.
Winona County:	
Oct. 5–Nov. 16—	
Winona	7
Minn., State total	459

MISSISSIPPI.

Marion County:	
June 1—	
Sandy Hook	1
Miss., State total	1

MISSOURI.

Buchanan County:	
Oct.—	
St. Joseph	3
Carroll County:	
Oct. 18—	
De Witt	1
Charlton County:	
Oct.—	
Brunswick	2
Jackson County:	
Oct.–Jan.—	
Kansas City	9
Machens	2
Ste. Genevieve County:	
July 6–Aug. 3—	
Ste. Genevieve	7
St. Louis City:	
May 16–Nov. 18—	
St. Louis	14
Mo., State total	38

MONTANA.

Lewis and Clark County:	
Jan.–June—	
Helena	2
Ravalli County:	
June 30–Oct. 31—	
Hamilton	1
Victor	1
Woodside	2
Rosebud County:	
July 25—	
Finch	1
Mont., State total	7

NEBRASKA.

Adams County:	
Sept.—	
Hastings	7
Buffalo County:	
Sept.—	
Kearney	1
Douglas County:	
Sept. 20—	
Omaha	3
Washington County:	
Oct. 27—	
Fort Calhoun	1
Webster County:	
Oct.—	
Cowles	2
Nebr., State total	14

NEVADA.

Churchill County:	
Oct. 31–Jan. 17—	
Fallon	2
Hazen	1

NEVADA—Continued.

	Cars.
Lyon County:	
Oct. 21–Jan. 14—	
Mason	1
Wabuska	1
Washoe County:	
Oct.–Mar.—	
Reno	5
Sparks	38
Wadsworth	2
Nev., State total	50

NEW HAMPSHIRE.

Cheshire County:	
Sept. 27–Oct. 14—	
Walpole	3
N. H., State total	3

NEW JERSEY.

Cumberland County:	
June 6–Sept. 27—	
Bridgeton	17
Cedarville	182
Fairton	90
Newport	40
Port Norris	1
South Vineland	1
Woodruff's	2
Gloucester County:	
June 22–July 21—	
Richwood	10
Hudson County:	
July–Jan.—	
Hoboken	3
Manhattan Piers	277
Weehawken	4
Sussex County:	
Sept.–Jan.—	
Sussex	13
Vernon	3
Warren County:	
July 10–Oct. 28—	
Allamuchy	8
Great Meadows	258
Oxford Furnace	9
N. J., State total	918

NEW MEXICO.

Bernalillo County:	
Sept. 10–Oct. 15—	
Albuquerque	4
San Juan County:	
Oct. 28—	
Aztec	1
N. Mex., State total	5

NEW YORK.

Albany County:	
Nov.—	
Albany	1
Allegany County:	
Oct. 25–Nov. 28—	
Burns	2
Bronx County:	
Sept.–Oct.—	
St. Johns Park	3
Broome County:	
Nov. 29—	
Binghampton	1
Cattaraugus County:	
Sept.–Feb.—	
Conewango	17
Dayton	1

NEW YORK—Continued.

	Cars.
Cayuga County:	
Aug.–Nov.—	
Crockett	2
Port Byron	18
Chatauqua County:	
Sept.—	
Cherry Creek	15
Chemung County:	
Nov.–Feb.—	
Elmira	3
Columbia County:	
Nov. 18—	
Mellenville	1
Erie County:	
Oct.—	
Buffalo	2
Franklin County:	
Nov.—	
Constable	1
Genesee County:	
Oct.–Mar. 21—	
Batavia	5
Elba	12
Le Roy	4
Livingston County:	
Oct.–Apr.—	
Avon	3
Lima	4
Livonia	3
South Lima	104
Madison County:	
Aug. 23–Mar. 17—	
Canastota	508
New Woodstock	1
North Chittenango	50
Monroe County:	
Oct.–Mar.—	
Brockport	1
Fairport	22
Henrietta	3
Pittsford	3
Rochester	2
Union Hill	9
Wayneport	3
New York County:	
July–June 8—	
New York	122
Niagara County:	
Oct.—	
Lockport	1
Middleport	1
Oneida County:	
Oct. 1–Dec. 2—	
Rome	75
Onondaga County:	
Oct.—	
East Syracuse	13
Syracuse	7
Woodward	2
Ontario County:	
Oct.–Nov.—	
Fishers	1
Geneva	1
Holcomb	4
Victor	10
Orange County:	
July–Jan.—	
Florida	124
Goshen	1
Middletown	9
New Hampton	131
Orange Farm	124
Pine Island	65
Port Jervis	3
Warwick	1
Orleans County	
July–Aug.—	
Albion	3
Ashwood	1
Medina	26

BULB CROPS—Continued.

Table 51.—ONIONS—Continued.

NEW YORK—Continued.

	Cars.
Oswego County:	
Sept.-Mar.—	
Central Square	13
Fulton	23
Furniss	20
Hannibal	10
Oswego	6
Rensselaer County:	
Oct. 13-31—	
Reynolds	3
Richmond County:	
Aug.-Jan.—	
St. George Lighterage	128
Seneca County:	
Oct.—	
Junius	5
Steuben County:	
Nov.-Jan.—	
Arkport	1
Wayland	4
Suffolk County:	
July 13-Aug. 30—	
Greenport	9
Orient	29
Ulster County:	
Jan. 22-Apr. 30—	
Accord	4
Wayne County:	
Sept.-June—	
Alton	1
Clyde	18
East Williamson	13
Fruitland	24
Lyons	20
Macedon	20
Marion	42
Newark	79
North Macedon	1
North Rose	53
Ontario	40
Palmyra	9
Port Gibson	1
Red Creek	6
Sodus	8
Sodus Center	38
Sodus Point	28
South Palmyra	1
Walworth	1
Williamson	39
Wolcott	44
N. Y., State total	2,270

NORTH CAROLINA.

Surry County:	
Aug. 15—	
Mt. Airy	1
N. C., State total	1

OHIO.

Ashtabula County:	
Sept.-Mar.—	
Conneaut	1
Geneva	7
Kingsville	4
Leon	1
Saybrook	5
Champaign County:	
Sept. 1—	
St. Paris	1
Cuyahoga County:	
June 22-Oct. 11—	
Cleveland	2
Cleveland Pier	1
Franklin County:	
July-Jan.—	
Columbus	6

OHIO—Continued.

	Cars.
Hamilton County:	
Aug. 2-May 13—	
Cincinnati	14
Columbia	1
Fernald	4
Newton	1
Hancock County:	
Sept. 18-Nov. 15—	
Vanlue	15
Hardin County:	
Aug. 5-Apr. 3—	
Ada	191
Alger	158
Dola	12
Foraker	105
Kenton	11
McGuffy	554
Holmes County:	
Sept.-Nov.—	
Big Prairie	4
Lakeville	1
Huron County:	
Oct. 7-Dec. 31—	
Chicago Junction	11
New London	8
Lake County:	
Sept.-Apr.—	
Madison	75
Mentor	1
Painesville	16
Perry	86
Unionville	2
Logan County:	
Sept. 6-Oct. 13—	
Belle Center	19
Lucas County:	
Sept. 2-Dec. 30—	
Toledo	11
Medina County:	
Oct. 6-31—	
Lodi	12
Ottawa County:	
Feb. 3-Nov. 27—	
Curtice	26
Gypsum	1
La Carne	5
Oak Harbor	1
Trowbridge	11
Portage County:	
Aug.-Jan.	
Aurora	2
Kent	20
Mantua	1
Moran	19
Ravenna	17
Suffield	1
Richland County:	
Sept.-Nov.—	
Plymouth	39
Seneca County:	
Sept. 16-Oct. 26—	
Alveda	7
Stark County:	
Aug.-Feb.—	
Canton	1
Hartville	38
Lawrence	1
Summit County:	
Oct. 12-Nov. 29—	
Hudson	3
Wayne County:	
Aug. 10-Dec. 30—	
Creston	3
Funk	294
Orrville	17
Williams County:	
Aug. 31-Oct. 11—	
Blakesley	1
Edgerton	5
Edon	27
Pioneer	1

OHIO—Continued.

	Cars.
Wyandot County:	
Aug. 31-Nov. 24—	
Carey	75
Ohio, State total	1,956

OKLAHOMA.

Bryan County:	
July 25—	
Mead	1
Pottawatomie County:	
Nov. 16—	
Shawnee	1
Okla., State total	2

OREGON.

Clackamas County:	
Nov.-Feb.—	
Canby	4
Clackamas	2
Milwaukie	2
Oregon City	1
Oswego	20
Wilsonville	3
Columbia County:	
Jan. 2-Feb. 17—	
Clatskanie Junction	2
Jackson County:	
Oct. 7—	
Medford	1
Lane County:	
Sept. 16-Dec. 29—	
Coburg	1
Cottage Grove	1
Creswell	1
Goshen	1
Linn County:	
Dec.-Feb.—	
Lebanon	3
Malheur County:	
Sept. 29—	
Nyssa	1
Marion County:	
Oct.-Mar.—	
Baron	3
Brooks	27
Gervais	6
Hubbard	13
Mount Angel	22
Salem	1
Woodburn	25
Multnomah County:	
Oct. 31-Feb.—	
Brooklyn	9
East Portland	63
Portland	49
Troutdale	1
Umatilla County:	
Oct. 19—	
Freewater	1
Union County:	
Oct.-Mar.—	
Imbler	1
La Grande	3
Union	1
Washington County:	
Sept. 29-Feb.—	
Banks	2
Beaverton	29
Cornelius	7
Garden Home	1
Gaston	1
Hillsboro	25
St. Marys	1
Sherwood	102
Tualatin	31
Oreg., State total	467

BULB CROPS—Continued.

Table 51.—ONIONS—Continued.

	Cars.
PENNSYLVANIA.	
Allegheny County:	
June 28–July 16—	
Allegheny	4
Bradford County:	
Aug. 15–Oct. 1—	
Snediker	1
Bucks County:	
Oct. 1–Dec. 30—	
Roelofs	1
Tullytown	1
Crawford County:	
Aug. 28–Dec. 1—	
Conneaut Lake	12
Geneva	2
Harmonsburg	2
Linesville	46
Erie County:	
Nov.–Apr.—	
Crayton	2
Fairview	6
Girard	3
Springfield	1
Lackawanna County:	
Nov. 11—	
Carbondale	1
Luzerne County:	
Nov. 14–21—	
Hazleton	3
Philadelphia County:	
Aug. 15–Oct. 31—	
Philadelphia	110
Tioga County:	
Oct. 1–15—	
Wellsboro Junction	1
York County:	
July 5–Aug. 30—	
Brogueville	12
Fawn Grove	5
Felton	17
Glen Rock	1
Glenville	8
Hanover	1
Hokes	5
New Freedom	6
New Park	3
Wiley	4
Pa., State total	258
RHODE ISLAND.	
Providence County:	
Aug.–July—	
Auburn	6
Providence	3
R. I., State total	9
SOUTH DAKOTA.	
Lake County:	
Oct. 16—	
Madison	1
Minnehaha County:	
Oct. 13—	
Ellis	1
S. D., State total	2
TEXAS.	
Atascosa County:	
Apr. 18–May 26—	
Poteet	58
Bexar County:	
Apr.–May 26—	
Elmendorf	1
Kirk	15
Cameron County:	
May–Sept.—	
Brownsville	1
Harlingen	3
Lyford	1
San Benito	43
TEXAS—Continued.	
Collin County:	
July 7–Sept.	Cars.
McKinney	56
Princeton	11
Comal County:	
June 10—	
New Braunfels	2
Dallas County:	
Feb.—	
Dallas	1
Dimmit County:	
Apr. 26–June 10—	
Asherton	656
Big Wells	197
Carrizo Springs	213
El Paso	2
Frio County:	
Apr. 8–June—	
Derby	75
Dilley	12
Pearsall	169
Hidalgo County:	
May 1–29—	
Alton	3
McAllen	17
Mercedes	10
Mission	300
Oblate	22
Palmhurst	18
Pharr	7
Jim Wells County:	
Apr. 15—	
Premont	1
Kleberg County:	
May 15—	
Riviera Station	1
Lasalle County:	
Mar. 30–June 10—	
Cotulla	113
Encinal	23
Fowlerton	28
Millett	3
Maverick County:	
Apr.—	
Eagle Pass	16
Medina County:	
May 25–31—	
Devine	11
Nueces County:	
Mar. 8–31—	
Calallen	10
Corpus Christi	30
Tarrant County:	
May 19–22—	
Fort Worth	3
Webb County:	
Mar. 1–June 19—	
Laredo	2,330
Zavalla County:	
Apr. 16–May 20—	
Crystal City	308
La Pryor	8
Tex., State total	4,778
UTAH.	
Boxelder County:	
Oct. 18–24—	
Garland	1
Tremonton	1
Willard	1
Cache County:	
Oct. 18—	
Wellsville	1
Davis County:	
Sept. 28–Oct. 17—	
Woods Cross	8
Morgan County:	
Sept.–Jan.—	
Morgan	8
UTAH—Continued.	
Salt Lake County:	
July 21–Mar. 9—	Cars.
Murray	7
Salt Lake	2
Utah County:	
Oct. 19–Nov. 18—	
American Fork	2
Pleasant Grove	1
Provo	5
Spanish Fork	1
Weber County:	
Sept. 30–Oct. 18—	
Ogden	5
Utah, State total	43
VERMONT.	
Windham County:	
Oct. 15–Nov. 20—	
South Vernon	4
Westminster	2
Vt., State total	6
VIRGINIA.	
Accomac County:	
June 25–Aug. 15—	
Belle Haven	24
Bloxom	2
Green Bush	1
Hallwood	12
Keller	3
Makemie Park	2
Mason	5
Mears	7
Melfa	21
Onley	20
Painter	10
Parksley	1
Tasley	5
Elizabeth City County:	
June 19–July 5—	
Old Point Comfort	1
Norfolk County:	
July 1–7—	
Norfolk	1
Port Norfolk	1
Northampton County:	
June 1–July 15—	
Cape Charles	9
Exmore	4
Nassawadox	2
Stanley	1
Wythe County:	
July 19–Oct. 12—	
Rural Retreat	4
June–Aug.—	
Occohannock River landings	99
June–July—	
Potomac River landings	2
June–July—	
Rappahannock River landings	2
Eastern Shore points by boat to Crisfield, Md.	80
Va., State total	319
WASHINGTON.	
Benton County:	
Nov. 2—	
Prosser	1
Chelan County:	
Oct. 16—	
Wenatchee	1
Clarke County:	
Dec. 30–Apr. 6—	
Battle Ground	1
Vancouver	5

BULB CROPS—Continued.

Table 51.—ONIONS—Continued.

WASHINGTON—Continued.

	Cars.
Pierce County:	
Aug. 14-21—	
Milton	2
Spokane County:	
Sept.-Feb. 19—	
Hillyard	2
Spokane	20
Yardley	13
Walla Walla County:	
July 13-May 22—	
Artesia	5
Finch	6
Waitsburg	2
Walla Walla	522
Yakima County:	
Sept.-Feb.—	
Donald	1
Grandview	1
North Yakima	31
Selah	1
Toppenish	45
Wapato	2
Wiley City	1
Wash., State total	662

WEST VIRGINIA.

	Cars.
Ohio County:	
July 25—	
Wheeling	1
Wood County:	
Aug. 18—	
Parkersburg	1
W. Va., State total	2

WISCONSIN.

Columbia County:	
Oct. 16-24—	
Kilbourn	2
Dodge County:	
Sept.—	
Chester	1
Fond du Lac County:	
Nov. 7—	
Ripon	1
Kenosha County:	
Aug.-Jan.—	
Berryville	153
Kenosha	24
Pleasant Prairie	2
Salem	1
Somers	22

WISCONSIN—Continued.

	Cars.
Milwaukee County:	
Sept.-May 19—	
Cudahy	5
Milwaukee	5
Outagamie County:	
Oct. 11-18—	
Shiocton	2
Racine County:	
Sept.-Jan.—	
Corliss	9
Racine	18
Racine Junction	10
Union Grove	2
Rock County:	
Oct. 2-6—	
Beloit	2
Trempealeau County:	
Nov. 18—	
Independence	1
Wis., State total	260

ROOT CROPS.

Table 52.—BEETS.

ILLINOIS.

	Cars.
Cook County:	
Oct.-Nov.—	
Chicago	11
South Holland	34
Winnebago County:	
Oct. 17-Nov. 7—	
Rockton	4
Ill., State total	49

KENTUCKY.

Jefferson County:	
May 26-June 24—	
Louisville	35
Ky., State total	35

LOUISIANA.

Jefferson Parish:	
Feb. 16-May 10—	
Kenner	5
Orleans Parish:	
May 3-13—	
New Orleans	7
La., State total	12

MASSACHUSETTS.

Franklin County:	
Nov. 9-29—	
Whately	4
Mass., State total	4

MISSISSIPPI.

Copiah County:	
May 8-June 10—	
Crystal Springs	22
Hazlehurst	2

MISSISSIPPI—Continued.

	Cars.
Madison County:	
May 20-27—	
Ridgeland	2
Miss., State total	26

NEW YORK.

Ontario County:	
Sept. 30-Dec. 27—	
Aloquin	1
Canandaigua	2
Gorham	2
Seneca Castle	6
Stanley	3
Suffolk County:	
Aug. 5-Oct. 20—	
Orient	1
Yates County:	
Nov. 10—	
Benton	1
N. Y., State total	16

NORTH CAROLINA.

Beaufort County:	
May 15-July 1—	
Washington	10
N. C., State total	10

OHIO.

Lucas County:	
Sept. 24-Nov. 27—	
Monclova	20
Medina County:	
Aug. 29-Oct. 24—	
Lodi	3
Paulding County:	
Oct. 19-Nov. 21—	
Broughton	21

OHIO—Continued.

	Cars.
Putnam County:	
Oct. 15-Nov. 21—	
Millers City	13
Sandusky County:	
Oct.—	
Clyde	2
Van Wert County:	
Oct. 6-Nov. 14—	
Dixon	18
Wood County:	
Oct. 6-26—	
Hatlon	7
Weston	13
Ohio, State total	97

SOUTH CAROLINA.

Charleston County:	
Jan. 27-June 9—	
Charleston	67
S. C., State total	67

VERMONT.

Windham County:	
July—	
Westminister	1
Vt., State total	1

VIRGINIA.

Elizabeth City County:	
May 25-June 14—	
Old Point Comfort	2
Norfolk County:	
May 6-June 29—	
Norfolk	61
Port Norfolk	7
Portsmouth	1
Va., State total	71

ROOT CROPS—Continued.

Table 53.—CARROTS.

	Cars.
CALIFORNIA.	
Los Angeles County:	
June 21—	
Los Angeles	1
Sacramento County:	
May 25–June 22—	
Sacramento	2
San Francisco County:	
Apr. 6—	
San Francisco	1
Cal., State total	4
COLORADO.	
Arapahoe County:	
Feb. 17—	
Englewood	1
Denver County:	
Nov. 7–Feb. 21—	
Denver	2
Weld County:	
Feb. 26—	
Greeley	1
Colo., State total	4
CONNECTICUT.	
New Haven County:	
June 26–July 5—	
New Haven	3
Conn., State total	3
ILLINOIS.	
Cook County:	
June–Mar.—	
Chicago	4
Des Plaines	4
Dunning	18
Lansing	6
Morton Grove	1
Oak Glen	1
Orchard Place	12
Dupage County:	
Mar. 20–Apr. 7—	
Bensenville	4
Kankakee County:	
Nov.–Mar.—	
Wichert	19
Ill., State total	69
INDIANA.	
Laporte County:	
Oct.–Jan.—	
Hanna	1
Stillwell	3
Marion County:	
June 16—	
Indianapolis	1
Ind., State total	5
KENTUCKY.	
Jefferson County:	
June 7–27—	
Louisville	11
Ky., State total	11
LOUISIANA.	
Jefferson Parish:	
Feb. 16–May 30—	
Kenner	8
Orleans Parish:	
Apr. 29—	
New Orleans	1
LOUISIANA—Continued.	
Ouachita Parish:	
May 30—	
Monroe	1
St. John the Baptist Parish:	
May—	
Montegut	2
Tangipahoa Parish:	
Feb. 12–May 27—	
Independence	3
Roseland	83
La., State total	98
MAINE.	
York County:	
Sept. 15–Oct. 15—	
Wells Beach	7
Me., State total	7
MARYLAND.	
Baltimore City:	
Oct. 9–Nov. 20—	
Baltimore	2
Md., State total	2
MASSACHUSETTS.	
Berkshire County:	
Oct.—	
Lenox Dale	1
Franklin County:	
Oct. 21–Nov. 25—	
Greenfield	1
Whately	2
Hampshire County:	
Apr. 7–Nov. 7—	
Northampton	3
Norwottuck	2
Mass., State total	9
MICHIGAN.	
Antrim County:	
Nov. 4—	
Alba	1
Arenac County:	
Oct. 25—	
Omer	1
Barry County:	
Oct. 3–30—	
Doster	3
Bay County:	
Oct.—	
Bay City	1
Benzie County:	
Oct. 31—	
Beulah	1
Berrien County:	
Oct. 12–17—	
Niles	2
Huron County:	
Dec.—	
Bad Axe	1
Bay Port	1
Ingham County:	
Sept. 1–Dec. 30—	
Mason	1
Jackson County:	
Feb. 17—	
Jackson	1
Kent County:	
Nov.—	
Lowell	1
Leelanau County:	
Dec.–Jan.—	
Suttons Bay	1
Lenawee County:	
Nov.—	
Tecumseh	2
MICHIGAN—Continued.	
Missaukee County:	
Dec. 20—	
Falmouth	1
Saginaw County:	
Oct. 31–Nov. 30—	
Saginaw	10
Van Buren County:	
Dec. 2—	
McDonald	1
Mich., State total	32
MINNESOTA.	
Aitkin County:	
Nov. 6—	
Hill City	1
St. Louis County:	
Oct. 6—	
Duluth	1
Minn., State total	2
MISSISSIPPI.	
Copiah County:	
May 11–June 24—	
Crystal Springs	116
Hazlehurst	2
Hopewell	1
Pike County:	
May 12—	
Osyka	2
Miss., State total	121
MONTANA.	
Ravalli County:	
Nov. 7—	
Hamilton	1
Mont., State total	1
NEW YORK.	
Cattaraugus County:	
Aug. 15–Dec. 31—	
Conewango	3
Clinton County:	
Oct. 15—	
Beekmantown	1
Cortland County:	
Dec. 29—	
Homer	1
Kings County:	
Mar. 1—	
Brooklyn	1
Livingston County:	
Nov. 1–Dec. 2—	
Caledonia	1
South Lima	6
Monroe County:	
Oct.–Nov. 28—	
Fairport	19
Henrietta	4
Mortimer	3
Rochester	1
Uptonville	5
Wayneport	4
New York County:	
Apr. 8—	
New York	1
Ontario County:	
Oct. 10–Dec. 30—	
Aloquin	2
Canandaigua	1
Gorham	4
Orleans	1
Phelps Junction	7
Seneca Castle	1
Stanley	4
Victor	1

ROOT CROPS—Continued.

Table 53.—CARROTS—Continued.

NEW YORK—Continued.

	Cars.
Orleans County:	
Oct.—	
Medina	1
Oswego County:	
Nov. 17–27—	
Fulton	1
Oswego	1
Rensselaer County:	
Oct. 18—	
Reynolds	1
Suffolk County:	
July–Mar.—	
Cutchogue	16
Greenport	17
Jamesport	3
Mattituck	6
Orient	41
Southold	28
Wayne County:	
Sept.–Jan.—	
Marion	10
Newark	10
Sodus Center	8
Yates County:	
Oct. 24–Nov. 10—	
Bellona	3
N. Y., State total	217

NORTH CAROLINA.

Beaufort County:	
May 15–July 1—	
Washington	2
N. C., State total	2

OHIO.

	Cars.
Ashtabula County:	
Sept. 17–21—	
Ashtabula	2
Hardin County:	
Oct. 6–Dec. 13—	
Foraker	5
Lake County:	
Oct.—	
Perry	1
Logan County:	
Oct. 3—	
Belle Center	1
Lucas County:	
Aug. 17–Sept. 11—	
Toledo	4
Ottawa County:	
Jan. 17—	
Curtice	1
Stark County:	
Oct. 4—	
Hartville	1
Wayne County:	
Sept.–Oct. 30—	
Funk	5
Ohio, State total	20

PENNSYLVANIA.

Crawford County:	
Sept. 25–Dec. 9—	
Linesville	26
Erie County:	
Oct.—	
Girard	1
Philadelphia County:	
Apr. 17—	
Philadelphia	9
Shackamaxon	1
Pa., State total	37

SOUTH CAROLINA.

	Cars.
Charleston County:	
Feb. 18–June 9—	
Charleston	86
S. C., State total	86

VIRGINIA.

Elizabeth City County:	
June 7–22—	
Old Point Comfort	1
Norfolk County:	
Apr. 28–July 14—	
Norfolk	6
Va., State total	7

WASHINGTON.

Yakima County:	
Sept. 16—	
North Yakima	1
Wash., State total	1

WISCONSIN.

Brown County:	
Oct. 6–27—	
Green Bay	1
Kenosha County:	
Nov. 8—	
Berryville	1
Milwaukee County:	
Oct. 23—	
Cudahy	1
Wis., State total	3

Table 54.—PARSNIPS.

COLORADO.

	Cars.
Denver County:	
Nov. 7—	
Denver	1
Colo., State total	1

ILLINOIS.

Cook County:	
Nov.–June—	
Chicago	5
Des Plaines	2
Dunning	3
Kankakee County:	
Nov. 16–21—	
Wichert	3
Ill., State total	13

INDIANA.

	Cars.
Noble County:	
Nov.—	
Kendallville	3
Ind., State total	3

KANSAS.

Shawnee County:	
Feb. 7—	
Topeka	1
Kans., State total	1

MICHIGAN.

Ingham County:	
Sept. 1–Dec. 31—	
Mason	15
Mich., State total	15

OHIO.

	Cars.
Lake County:	
Nov.—	
Perry	1
Ohio, State total	1

WISCONSIN.

Milwaukee County:	
Nov. 10—	
Cudahy	1
Wis., State total	1

Table 55.—RADISHES.

ALABAMA.

	Cars.
Butler County:	
Mar. 28–May 2—	
Greenville	26
Escambia County:	
Apr. 6–16—	
Brewton	1
Ala., State total	27

ARKANSAS.

Hempstead County:	
Apr. 8–18—	
Blevins	5
Ark., State total	5

CALIFORNIA.

	Cars.
Los Angeles County:	
Mar. 23—	
Los Angeles	1
Cal., State total	1

GEORGIA.

Chatham County:	
Jan. 24—	
Savannah	1
Ga., State total	1

ILLINOIS.

	Cars.
Alexander County:	
May 2–6—	
Cache	2
Ill., State total	2

INDIANA.

Vigo County:	
May 8–28—	
Perkins	4
Ind., State total	4

ROOT CROPS—Continued.

Table 55.—RADISHES—Continued.

KENTUCKY.

	Cars.
Jefferson County:	
May 26–June 2—	
Louisville	2
Ky., State total	2

LOUISIANA.

Tangipahoa Parish:	
Mar. 10–Apr. 24—	
Roseland	31
La., State total	31

MISSISSIPPI.

	Cars.
Copiah County:	
Apr. 18—	
Crystal Springs	1
Miss., State total	1

OHIO.

Cuyahoga County:	
May—	
Cleveland Pier	1
Ohio, State total	1

SOUTH CAROLINA.

	Cars.
Beaufort County:	
Jan. 20–Apr. 11—	
Beaufort	9
Port Royal	12
S. C., State total	21

VIRGINIA.

Norfolk County:	
Apr. 30–Nov. 17—	
Norfolk	370
Port Norfolk	1
Portsmouth	4
Va., State total	375

Table 56.—RUTABAGAS.

ALABAMA.

	Cars.
Mobile County:	
Feb. 1–24—	
Theodore	7
Ala., State total	7

ILLINOIS.

Cook County:	
Oct. 30—	
Chicago	1
Will County:	
Oct. 26—	
Joliet	1
Ill., State total	2

MICHIGAN.

Alpena County:	
Nov. 11—	
Lachine	1
Delta County:	
Oct. 21–Nov. 8—	
Narenta	1
Vans Harbor	5
Grand Traverse County:	
Dec. 6—	
Traverse City	1
Houghton County:	
Nov. 4—	
Lake Linden	1
Marquette County:	
Oct. 31–Nov. 2—	
Lawson	1
Republic	1
Menominee County:	
Nov. 11—	
Spalding	1
Montmorency County:	
Nov. 7—	
Hillman	1
Osceola County:	
Oct. 6–28—	
Marion	2
Schoolcraft County:	
Nov. 18—	
Manistique	1
Mich., State total	16

MINNESOTA.

Aitkin County:	
Nov. 6—	
Hill City	1
Clearwater County:	
Dec. 15—	
Gonvick	1
Itasca County:	
Oct. 15–Nov. 30—	
Grand Rapids	2
Swan River	3

MINNESOTA—Continued.

	Cars.
Marshall County:	
Oct. 14—	
Holt	1
Millelacs County:	
Oct. 14–30—	
Onamia	2
Pine County:	
Sept. 30–Oct. 14—	
Kerrick	1
Sandstone	1
Polk County:	
Nov. 1—	
McIntosh	1
Ramsey County:	
Oct. 2–Feb. 20—	
St. Paul	4
St. Louis County:	
Oct. 18–Nov. 3—	
Virginia	2
Todd County:	
Oct. 5–Nov. 4—	
Browerville	6
Long Prairie	12
Minn., State total	37

PENNSYLVANIA.

Somerset County:	
Sept. 20–Nov. 6—	
Friedens	1
Listie	1
Stoyestown	1
Pa., State total	3

VIRGINIA.

Wythe County:	
Aug. 10–Oct. 23—	
Crockett	1
Rural Retreat	12
Va., State total	13

WASHINGTON.

Yakima County:	
Oct. 6–Apr. 17—	
Grandview	1
Harwood	1
North Yakima	4
Sunnyside	2
Wash., State total	8

WISCONSIN.

Barron County:	
Oct. 4–Dec. 22—	
Almena	3
Barronett	8
Comstock	3
Cumberland	61
Rice Lake	1

WISCONSIN—Continued.

	Cars.
Brown County:	
Oct. 4–Nov. 23—	
Green Bay	6
Burnett County:	
Nov. 29—	
Siren	1
Columbia County:	
Oct. 21–Nov. 1—	
Fall River	1
Kilbourn	1
Douglas County:	
Oct. 21–Nov. 4—	
Gordon	1
Lake Nebagamon	2
Wascott	1
Florence County:	
Dec. 30—	
Florence	1
Forest County:	
Nov. 20—	
Wabeno	1
Marinette County:	
Nov. 7–11—	
Bagley Junction	1
Wagner	1
Walsh	1
Wausaukee	1
Oneida County:	
Nov. 5–25—	
Pelican	2
Ozaukee County:	
Oct. 16—	
Belgium	1
Polk County:	
Oct.—	
Centuria	2
Price County:	
Nov. 1–15—	
Catawba	1
Prentice	1
Rusk County:	
Oct. 4–Nov.—	
Tony	1
Weyerhaeuser	1
Sawyer County:	
Nov. 6–23—	
Hayward	3
Taylor County:	
Nov. 25—	
Stetsonville	1
Washburn County:	
Oct. 19–Nov. 4—	
Trego	3
Waupaca County:	
Nov.—	
Scandinavia	1
Waupaca	2
Winnebago County:	
Oct. 27—	
Oshkosh	1
Wood County:	
Nov. 30–Dec. 15—	
Marshfield	3
Wis., State total	118

ROOT CROPS—Continued.

Table 57.—TURNIPS.

	Cars.
ALABAMA.	
Mobile County:	
Feb. 1–17—	
Theodore	7
Ala., State total	7
ARKANSAS.	
Randolph County:	
Aug. 1–25—	
Biggers	12
Ark., State total	12
CALIFORNIA.	
Los Angeles County:	
Nov. 22—	
Los Angeles	1
Sacramento County:	
May 1–12—	
Sacramento	3
Cal., State total	4
COLORADO.	
Denver County:	
Sept. 19–Nov. 1—	
Denver	5
Weld County:	
Sept. 30—	
Lucerne	1
Colo., State total	6
GEORGIA.	
Chatham County:	
Sept.–Oct.—	
Savannah	4
Ga., State total	4
ILLINOIS.	
Cook County:	
Feb. 9–Dec. 14—	
Chicago	20
Dupage County:	
Nov. 18—	
Bensenville	1
Kankakee County:	
Nov.–Jan.—	
Wichert	8
St. Clair County:	
Nov.—	
East St. Louis	1
Will County:	
Oct. 9—	
Joliet	2
Ill., State total	32
INDIANA.	
Fulton County:	
Sept. 26–Oct. 3—	
Akron	2
Jasper County:	
Oct. 31–Nov. 1—	
Fair Oaks	2
Laporte County:	
Nov.–Apr.—	
Hanna	1
Union Center	3
St. Joseph County:	
Nov.—	
North Liberty	1
Ind., State total	9
KANSAS.	
Johnson County:	
Oct. 3–Dec. 4—	
De Soto	6
Wilder	31
Leavenworth County:	
Oct. 28–Nov. 28—	
Lenape	3
Linwood	2
Wyandotte County:	
Oct. 25–Jan. 12—	
Bonner Springs	14
Edwardsville	8
Turner	3
Kans., State total	70
KENTUCKY.	
Jefferson County:	
Dec.–June—	
Louisville	10
Ky., State total	10
LOUISIANA.	
St. John the Baptist Parish:	
Jan. 23–June 22—	
Montegut	3
La., State total	3
MAINE.	
Aroostook County:	
Dec. 18—	
Houlton	1
Sagadahoc County:	
Dec. 30—	
Bowdoinham	1
Washington County:	
Oct. 18–Nov. 14—	
Ayer's Junction	2
Columbia	1
Perry	3
Me., State total	8
MARYLAND.	
Baltimore City:	
Feb. 17–June 26—	
Baltimore	9
Worcester County:	
June 17–July 17—	
Beaver Dam	7
Pocomoke	8
Snow Hill	2
Nov.:	
Choptank River landings	1
Nov.:	
Wicomico River landings	1
Md., State total	28
MASSACHUSETTS.	
Barnstable County:	
Oct.–Dec.—	
North Eastham	4
Berkshire County:	
Nov.—	
Lenox Dale	1
Pittsfield	2
Essex County:	
Dec. 9—	
Lawrence	1
Franklin County:	
Nov. 9—	
Shelburne Falls	1
MASSACHUSETTS Contd.	
Suffolk County:	
Oct. 3–Nov. 18	
Boston	4
Mass., State total	13
MICHIGAN.	
Barry County:	
Nov. 7–15	
Doster	2
Emmet County:	
Nov. 6–Dec. 17	
Harbor Springs	4
Ingham County:	
Sept. 1–Dec. 31—	
Mason	2
Iosco County:	
Jan. 11—	
McIvar	1
Saginaw County:	
Oct. 21—	
Saginaw	2
Wayne County:	
Feb. 2–Dec. 27—	
Detroit	17
Mich., State total	28
MINNESOTA.	
Hennepin County:	
Sept.–Dec.—	
Minneapolis	20
Ramsey County:	
Oct. 6—	
St. Paul	1
Todd County:	
Oct. 31—	
Long Prairie	1
Minn., State total	22
MISSISSIPPI.	
Copiah County:	
Apr. 7–May 16—	
Crystal Springs	7
Miss., State total	7
MISSOURI.	
Clay County:	
Sept. 9–Oct. 17—	
Birmingham	15
Ray County:	
Oct. 28—	
Orrick	1
St. Louis City:	
Oct.—	
St. Louis	3
Mo., State total	19
NEW JERSEY.	
Cumberland County:	
July 7–Oct. 9—	
Bridgeton	12
Monmouth County:	
July 5–Sept. 13—	
Freehold	2
Port Monmouth	17
N. J., State total	31
NEW YORK.	
Clinton County:	
Nov. 8—	
Beekmantown	1

ROOT CROPS—Continued.

Table 57.—TURNIPS—Continued.

NEW YORK—Continued.

	Cars.
Erie County:	
Nov. 20—	
Orchard Park	1
Kings County:	
Jan. 29—	
Brooklyn	2
Madison County:	
Nov. 2—	
Hubbardsville	1
Otsego County:	
Oct.-Nov. 13—	
International Siding	1
Mount Vision	2
Suffolk County:	
Apr. 4-Dec. 22—	
Bridgehampton	6
Greenlawn	1
Miller's Place	3
Northport	2
Port Jefferson	12
Wayne County:	
Oct. 31-Dec. 18—	
Newark	2
Sodus Center	2
N. Y., State total	36

NORTH DAKOTA.

Pembina County:	
Nov. 4—	
Pembina	1
N. Dak., State total	1

OHIO.

Ashtabula County:	
Dec. 14—	
Ashtabula Harbor	1
Medina County:	
Oct. 21-30—	
Lodi	4
Putnam County:	
Oct. 13—	
Leipsic	1

OHIO—Continued.

	Cars.
Wayne County:	
Oct. 16-Nov. 23—	
Orrville	2
Ohio, State total	8

PENNSYLVANIA.

Bucks County:	
Feb. 10—	
Neshaminy Falls	1
Philadelphia County:	
Feb.—	
Philadelphia	3
Susquehanna County:	
Nov. 24-Dec. 14—	
Kingsley	1
Montrose	1
Wayne County:	
Oct. 28-Nov. 25—	
Honesdale	7
Pa., State total	13

UTAH.

Utah County:	
Nov. 11—	
American Forks	1
Utah, State total	1

VERMONT.

Bennington County:	
Nov. 10—	
North Bennington	1
Orleans County:	
Nov. 11-Dec. 11—	
Barton	1
Derby Line	1
Vt., State total	3

VIRGINIA.

Accomac County:	
June 15-July 15—	
Bloxom	1
Hallwood	2
Le Cato	1
New Church	3

VIRGINIA—Continued.

	Cars.
Norfolk County:	
May 5-June 30—	
Norfolk	8
Northampton County:	
June—	
Birds Nest	1
Wythe County:	
Aug. 4-Oct. 26—	
Rural Retreat	1
Va., State total	17

WASHINGTON.

Walla Walla County:	
June 24-Oct. 31—	
Walla Walla	5
Yakima County:	
June 25-Nov. 3—	
Grandview	1
North Yakima	10
Toppenish	1
Wash., State total	17

WEST VIRGINIA.

Wood County:	
Nov. 4—	
Parkersburg	1
W. Va., State total	1

WISCONSIN.

Barron County:	
Nov. 1—	
Rice Lake	1
Brown County:	
Oct. 4-Dec. 31—	
Green Bay	6
Racine County:	
Oct.—	
Union Grove	3
Wis., State total	10

BRASSICAS.

Table 58.—BROCCOLI.

CALIFORNIA.

	Cars.
San Mateo County:	
Mar. 4-5—	
Colma	2
Cal., State total	2

OREGON.

	Cars.
Douglas County:	
Feb. 18-Mar. 30—	
Roseburg	48
Oreg., State total	48

Table 59.—BRUSSELS SPROUTS.

NEW YORK.

	Cars.
Suffolk County:	
Aug.-Nov.—	
Peconic	100
N. Y., State total	100

Table 60.—CABBAGES.

ALABAMA.

	Cars.
Mobile County:	
Apr. 20-June 1—	
Bayou LaBatre	1
Mobile	176
Russell	10

ALABAMA—Continued.

	Cars.
Mobile County—Continued.	
Apr. 20-June 1—	
St. Elmo	8
Tacon	69
Theodore	194

ALABAMA—Continued.

	Cars.
Sumter County:	
June 15-July 15—	
York	2
Ala., State total	460

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

ARIZONA.

	Cars.
Greenlee County:	
Dec. 6—	
Duncan	1
Ariz., State total	1

ARKANSAS.

White County:	
June—	
Searcy	1
Ark., State total	1

CALIFORNIA.

Imperial County:	
June 16–July 8—	
Imperial	78
Los Angeles County:	
Jan. 24–Dec. 30—	
Central Avenue	4
Colima	3
Compton	24
Downey	6
El Monte	28
Florence	3
Gardena	1
Hobart	7
Hynes	1
Inglewood	3
Kester	4
Kester Junction	1
Los Angeles	146
Los Nietos	20
Mount Olivet	1
Newark	36
Norwalk	23
Pico	4
Puenta	4
Rowland	2
San Gabriel	4
Van Nuys	2
Vernondale	5
Watts	8
Whittier	3
Wilmington	1
Orange County:	
Mar. 3–Nov. 21—	
Brea	20
Buena Park	20
Fullerton	95
Garden Grove	66
La Habra	13
Northam	2
Olive	9
San Juan Capistrano	1
Stanton Junction	5
West Anaheim	163
Yorba	2
Yorba Linda	1
Sacramento County:	
May 5–Dec. 22—	
Sacramento	17
San Francisco County:	
Mar. 3–May 30—	
Elkton	2
San Francisco	4
San Joaquin County:	
Oct. 23–Nov. 25—	
Stockton	18
San Mateo County:	
Sept. 13–May 17—	
Colma	81
Race Track Junction	3
San Bruno	7
Tehama County:	
Aug. 1—	
Rosewood	1
Yolo County:	
Nov. 15—	
Davis	1
Cal., State total	953

COLORADO.

	Cars.
Adams County:	
July 28–Nov. 6—	
Barr	13
Brighton	325
Darlow	4
East Lake	20
Hazeltine	17
Patron	5
Westminster	5
Arapahoe County:	
Sept. 7–Nov. 22—	
Littleton	14
Petersburg	9
Denver County:	
July 8–Nov. 7—	
Denver	772
Eagle County:	
Aug.—	
Avon	1
Fremont County:	
Aug. 11–Oct. 28—	
Florence	1
Union	1
Larimer County:	
July 15–Nov. 26—	
Fort Collins	8
Harmony	1
Timnath	5
Morgan County:	
Oct. 6–20—	
Brush	2
Pueblo County:	
July 17–Oct. 17—	
Pinon	1
Pueblo	17
Rio Grande County:	
Oct. 3–27—	
Monte Vista	2
Sedgwick County:	
Aug. 17–22—	
Julesburg	6
Weld County:	
July–Feb.—	
Ault	117
Cloverly	36
Eaton	75
Erie	7
Gill	1
Greeley	396
Ione	143
Kersey	1
La Salle	10
Lucerne	41
Lupton	260
Milliken	61
Platteville	17
St. Vrains	4
Severance	14
Traceyville	120
Wattenberg	185
Windsor	23
Colo., State total	2,740

FLORIDA.

Alachua County:	
Jan.–May—	
Clyatt	9
Evinston	50
Gainesville	8
Kirkwood	8
Micanopy	7
Wacahoota	5
Hillsborough County:	
Jan. 25–Mar. 23—	
Dover	2
Plant City	10
Ybor City	5
Jackson County:	
Feb.—	
Marianna	1

FLORIDA—Continued.

	Cars.
Lake County:	
Dec.–June—	
Leesburg	37
Lisbon	5
Whitney	15
Levy County:	
Jan.–Apr. 10—	
Williston	9
Manatee County:	
Dec.–Apr.—	
Bradentown	15
Ellenton	23
Parish	7
Marion County:	
Jan.–Mar.—	
Hickman	4
Santos	3
South Side	30
Polk County:	
Jan. 15–June 5—	
Bartow	200
Lakeland	3
Seminole County:	
Jan. 15–May 30—	
Sanford	23
Sumter County:	
Feb.–Apr. 12—	
Coleman	358
Panasoffkee	5
Sumterville	22
Wildwood	3
Fla., State total	867

GEORGIA.

Dougherty County:	
Aug. 11—	
Albany	1
Fulton County:	
Apr. 19—	
Atlanta	2
Spalding County:	
July 15—	
Pomona	1
Ga., State total	4

IDAHO.

Bingham County:	
Nov.–Feb.—	
Firth	8
Shelley	4
Cassia County:	
Nov. 4—	
Burley	1
Idaho, State total	13

ILLINOIS.

Adams County:	
June 2–July 15—	
Quincy	32
Alexander County:	
Oct. 19—	
Cairo	1
Cook County:	
June–Jan.—	
Bernice	1
Chicago	9
Dolton	21
Globe	6
Homewood	1
Lansing	27
Riverdale	21
Thornton	6
Kankakee County:	
Aug. 4–Oct. 18—	
Momence	4
Wichert	12

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

ILLINOIS—Continued.

	Cars.
Knox County:	
July—	
Galesburg	1
Lake County:	
Sept. 27–Nov. 27—	
Gurnee	3
Hebron	13
Winthrop Harbor	1
St. Clair County:	
June 22–Nov. 2—	
East St. Louis	3
Vermilion County:	
June—	
Westville	1
Will County:	
Nov.–Jan.—	
Joliet	12
Winnebago County:	
Sept. 14–Oct. 28—	
Rockton	10
Ill., State total	185

INDIANA.

Dekalb County:	
Nov.—	
Auburn	3
Elkhart County:	
Aug. 22–Sept. 29—	
Nappanee	22
Gibson County:	
July 23—	
Princeton	1
Hamilton County:	
Oct.—	
Westfield	2
Kosciusko County:	
Sept.—	
Milford	2
Lake County:	
Sept.–Oct. 28—	
Highlands	11
Ross	1
Laporte County:	
Aug. 8–Nov. 28—	
Hanna	9
St. Joseph County:	
Sept.–Oct.—	
New Carlisle	1
North Liberty	3
Walkerton	1
Starke County:	
Oct.—	
Hamlet	1
Ind., State total	57

IOWA.

Cerro Gordo County:	
July—	
Clear Lake	4
Des Moines County:	
July 17–Sept. 14—	
Mediapolis	31
Louisa County:	
Aug. 1—	
Oakville	1
Mitchell County:	
Aug. 16–Sept. 25—	
St. Ansgar	32
Muscatine County:	
July 1–Nov. 15—	
Fruitland	3
Muscatine	168
Nichols	102
Palo Alto County:	
Oct. 16–23—	
Emmetsburg	2
Scott County:	
July–Aug. 30—	
Blue Grass	18
Davenport	4

IOWA—Continued.

	Cars.
Wapello County:	
May 9–July 15—	
Ottumwa	2
Iowa, State total	367

KANSAS.

Allen County:	
June 20–27—	
Iola	2
Atchison County:	
Nov. 17–Dec. 9—	
Atchison	3
Leavenworth County:	
Oct. 14–19—	
Leavenworth	2
Montgomery County:	
May 15—	
Coffeyville	1
Saline County:	
Jan. 18—	
Salina	1
Shawnee County:	
May 2–Oct. 31—	
Topeka	17
Kans., State total	26

KENTUCKY.

Bullitt County:	
July–Aug.—	
Medora	5
Jefferson County:	
June–Feb.—	
Buechel	2
Louisville	167
McCracken County:	
July—	
Paducah	1
Warren County:	
June 27—	
Bowling Green	1
Ky., State total	176

LOUISIANA.

Iberia Parish:	
Feb. 12–Mar. 6—	
New Iberia	2
Jefferson Parish:	
May 2–16—	
Harvey	17
Kenner	3
Orleans Parish:	
Apr. 26–Dec. 30—	
New Orleans	61
Pointe Coupee Parish:	
Apr.–May 25—	
New Roads	13
Rapides Parish:	
Jan. 1–Dec. 31—	
Alexandria	7
St. Charles Parish:	
Jan. 1–June 23—	
Destrehan	79
Hahnville	4
St. Rose	79
St. John the Baptist Parish:	
Jan. 23–May 27—	
Montegut	34
St. Landry Parish:	
Apr. 15–May 27—	
Arnaudville	31
St. Tammany Parish:	
Apr. 10–May 28—	
Slidell	57
Tangipahoa Parish:	
Apr. 11–May 19—	
Roseland	16
Tangipahoa	3
Tickfaw	2

LOUISIANA—Continued.

	Cars.
West Feliciana Parish:	
May 10–13—	
Bayou Sara	2
La., State total	410

MAINE.

Cumberland County:	
Nov. 14–Dec. 27—	
Portland	9
Scarboro	7
Me., State total	16

MARYLAND.

Baltimore City:	
June 7–Feb. 12—	
Baltimore	327
Baltimore County:	
June 15–July 13—	
Bengies	8
Sparrows Point	177
Wicomico County:	
Feb.—	
Salisbury	1
May–Nov.—	
Pocomoke River landings	15
Md., State total	528

MASSACHUSETTS.

Berkshire County:	
Sept. 23–Oct. 28—	
Adams	6
Lenox Dale	1
North Adams	2
Pittsfield	2
West Pittsfield	3
Essex County:	
Sept. 26—	
Lawrence	1
Franklin County:	
Nov. 8—	
Greenfield	1
Hampshire County:	
Oct. 20–Nov. 2—	
Hadley	2
Northampton	1
Suffolk County:	
June 2–Dec. 13—	
Boston	3
Mass., State total	22

MICHIGAN.

Baraga County:	
Oct. 20–Nov. 9—	
Baraga	4
Keweenaw Bay	9
Benzie County:	
Oct. 30–Dec. 15—	
Beulah	8
Frankfort	35
Berrien County:	
Sept. 15–Nov.—	
Baroda	8
Niles	7
Branch County:	
Sept.–Jan.—	
Coldwater	9
Quincy	9
Eaton County:	
Dec.—	
Charlotte	1
Grand Traverse County:	
Dec. 6—	
Traverse City	1

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

MICHIGAN—Continued.

	Cars.
Hillsdale County:	
Sept.–Dec.—	
Hillsdale	2
Jonesville	4
Litchfield	1
Moscow	3
Houghton County:	
Sept.—	
Alston	3
Ingham County:	
Sept. 1–Dec. 30—	
Mason	43
Jackson County:	
Sept.–Mar. 4—	
Hanover	3
Jackson	1
Kent County:	
Oct.—	
Byron Center	8
Manistee County:	
Oct.—	
Arcadia	1
Menominee County:	
Oct. 25—	
Carney	1
Monroe County:	
Nov.—	
Dundee	1
Ottawa County:	
Oct. 14—Nov. 23—	
Nunica	4
St. Joseph County:	
Nov.—	
Three Rivers	4
Wasepi	1
Saginaw County:	
Aug. 31–Dec.—	
Saginaw	26
Saginaw, E. Side	22
Saginaw, W. Side	44
Mich., State total	263

MINNESOTA.

Carver County:	
Dec. 12—	
Victoria	1
Dodge County:	
July–Nov.—	
Dodge Center	7
Freeborn County:	
July—	
Albert Lea	2
Hennepin County:	
July 20–Jan.—	
Camden Place	17
Minneapolis	20
Minnehaha	7
Robbinsdale	2
Marshall County:	
Oct. 14—	
Holt	1
Mower County:	
Oct. 4–6—	
Austin	2
Pine County:	
Oct. 2–Jan.—	
Brook Park	1
Sandstone	1
Polk County:	
Oct. 25–26—	
McIntosh	2
Ramsey County:	
Aug. 17–Nov. 2—	
St. Paul	15
Red Lake County:	
June—	
Red Lake Falls	1
Rice County:	
Mar. 3—	
Northfield	2

MINNESOTA—Continued.

St. Louis County:	
Oct. 28–Nov. 1—	
Duluth	2
Stearns County:	
Oct. 11—	
Kimball Prairie	1
Wabasha County:	
Aug. 8–Jan.—	
Elgin	7
Kellogg	39
Minneiska	1
Plainview	55
Wabasha	34
Weaver	5
Winona County:	
Sept. 13–Oct. 30—	
Altura	2
Bethany	7
Lewiston	19
Stockton	2
Sugar Loaf	2
Winona	7
Wright County:	
Oct. 21–24—	
Albertville	2
Minn., State total	266

MISSISSIPPI.

Adams County:	
May 20—	
Natchez	1
Copiah County:	
Apr. 18–June 10—	
Crystal Springs	250
Gallman	52
Gatesville	2
Georgetown	2
Hazlehurst	46
Hopewell	2
Hinds County:	
Apr. 24–25—	
Terry	3
Jackson County:	
Apr. 12–27—	
Pascagoula	3
Jefferson County:	
Apr.—	
Fayette	13
Marion County:	
May 19–June 6—	
Columbia	7
Newton County:	
May 8–June 13—	
Hickory	5
Newton	4
Walthall County:	
May 16–June 2—	
Tylertown	5
Miss., State total	395

MISSOURI.

Buchanan County:	
June 29–July 19—	
St. Joseph	8
Jackson County:	
June–July—	
Kansas City	7
Leeds	3
Mo., State total	18

MONTANA.

Beaverhead County:	
Oct. 31—	
Dillon	1
Lewis and Clark County:	
Jan.–June—	
Helena	3

MONTANA—Continued.

	Cars.
Missoula County:	
Aug. 21—	
Missoula	1
Ravalli County:	
Oct. 21—	
Woodside	2
Mont., State total	7

NEBRASKA.

Dodge County:	
Oct. 26—	
Fremont	1
Douglas County:	
July 26–Aug. 2—	
Florence	2
Franklin County:	
Oct.—	
Naponee	1
Garfield County:	
Oct. 12–Nov. 18—	
Burwell	2
Hall County:	
Apr. 26–May 18—	
Grand Island	4
Kimball County:	
Sept. 18–Oct. 28—	
Kimball	6
Owasco	1
Morrill County:	
Sept.—	
Bridgeport	1
Nuckolls County:	
Oct. 14—	
Superior	1
Polk County:	
Oct. 30—	
Stromsburg	1
Scotts Bluff County:	
Oct. 1–Nov. 8—	
Mitchell	7
Nebr., State total	27

NEW JERSEY.

Burlington County:	
Sept. 14–Oct. 4—	
Bordentown	3
Lumberton	1
Hudson County:	
June 14—	
Hoboken	1
Monmouth County:	
June 5–Aug. 26—	
Marlboro	4
Red Bank	4
Tennent	2
Union County:	
Nov. 20—	
Elizabeth	1
N. J., State total	16

NEW MEXICO.

Bernalillo County:	
June 25–July 30—	
Albuquerque	7
Dona Ana County:	
June 6–July 11—	
Dona Ana	3
Las Cruces	3
N. Mex., State total	13

NEW YORK.

Albany County:	
Aug.–Nov.—	
Albany	3
Selkirk	1

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

NEW YORK—Continued.

	Cars.
Broome County:	
Sept. 9–Dec. 16—	
Binghamton	25
Conklin	8
Cayuga County:	
Sept.–Apr.—	
Auburn	37
Genoa	4
Ira	2
Mapleton	12
Merrifield	5
Moravia	73
North Port Byron	7
North Weedsport	2
Owasco Lake	9
Sennett	8
Venice Center	1
Weedsport	8
Chemung County:	
Dec. 5–Feb. 2—	
Elmira	1
Van Etten	2
Chenango County:	
Sept. 13–Dec. 16—	
Afton	22
Galena	10
Greene	1
Mount Upton	1
Norwich	2
Oxford	3
Sherburne	65
Sherbourne Four Corners	18
Smyrna	26
South New Berlin	6
Clinton County:	
Nov. 2—	
Beekmantown	2
Cortland County:	
Sept.–Feb. 19—	
Blodgett Mills	12
Cortland	143
Cuyler	10
East Freetown	1
East Homer	15
Homer	54
Little York	92
McGraw	16
Marathon	9
Messengerville	4
North Harford	3
Truxton	10
Delaware County:	
Oct. 21–Nov. 30—	
Delphi	1
Sidney	7
Dutchess County:	
Nov. 5–14—	
Poughquag	2
Erie County:	
Nov.–Mar. 25—	
Akron Falls	1
Clarence	1
Clarence Center	5
Crittenden	1
Dellwood	7
Getzville	2
Town Line	1
Genesee County:	
Oct.–Mar.—	
Alabama	1
Alexander	1
Batavia	65
Bergen	2
Corfu	10
East Bethany	2
East Pembroke	5
Elba	6
Fargo	1
Le Roy	13

NEW YORK—Continued.

	Cars.
Genesee County—Contd.	
Oct.–Mar.—	
Oakfield	10
Pavilion Center	2
Pembroke	9
Greene County:	
Nov.—	
Catskill	1
Herkimer County:	
Nov.—	
Frankfort	4
Herkimer	2
Little Falls	1
Salisbury Center	1
Kings County:	
Sept.–Feb.—	
Brooklyn	10
Livingston County:	
July–Feb.—	
Avon	8
Caledonia	5
Conesus	8
Geneseo	12
Hemlock	3
Inverness	9
Lakeville	11
Lima	72
Linwood	6
Livonia	48
South Lima	4
South Livonia	3
Madison County:	
Oct.–Jan.—	
Ballina	8
De Ruyter	5
Earlville	4
Erietown	2
Hamilton	7
Hubbardsville	32
Morrisville	11
New Woodstock	10
Poolville	2
Randallsville	30
Rippleton	1
Sheds Corners	10
Solsville	3
Monroe County:	
Oct.–Apr.—	
Adams Basin	53
Brockport	34
Charlotte	7
Chili	9
Chili Center	2
Churchville	13
Elm Grove	87
Fairport	128
Garbutt	3
Greece	8
Hamlin	17
Henrietta	56
Hilton	16
Honeoye Falls	83
Industry	2
Mendon	9
Morton	2
Mumford	35
Pittsford	14
Ridgeland	7
Rochester	12
Rochester Junction	15
Rush	2
Scottsville	3
Spencerport	102
Union Hill	52
Uptonville	6
Wadsworth	16
Walker	11
Wayneport	7
Webster	32
West Henrietta	42
West Rush	3

NEW YORK—Continued.

	Cars.
Montgomery County:	
Oct.–Nov.—	
Amsterdam	13
Fonda	2
Nassau County:	
Aug. 15–Nov. 10—	
Central Park	7
Farmingdale	6
Locust Valley	2
Syosset	33
New York County:	
June 4–Nov.—	
New York	5
Niagara County:	
Aug.–Apr.—	
Appleton	121
Barker	16
Burt	4
Corwins	30
Gasport	4
Lockport	44
Middleport	5
Newfane	75
North Tonawanda	1
Olcott	9
Pendleton Center	15
Ransomville	2
Wilson	10
Wrights	109
Oneida County:	
Oct.–Dec.—	
Greenway	3
Utica	5
Whitesboro	2
Onondaga County:	
Sept.–Mar. 5—	
Apulia	71
Baldwinsville	64
Camillus	2
Clay	23
East Syracuse	3
Fayetteville	1
Halfway	48
Jamesville	23
Jordan	11
Kirkville	13
Lamson	13
Manlius	2
Martisco	374
Memphis	6
Onativia	91
Skaneateles Junction	178
Syracuse	1
Tully	287
Warner	12
Ontario County:	
Sept.–Feb.—	
Aloquin	62
Canandaigua	32
Clifton Springs	64
Farmington	12
Fishers	10
Geneva	30
Gorham	74
Hall	120
Holcomb	8
Ionia	111
Manchester	2
Mertensia	2
Oaks Corners	44
Orleans	8
Phelps	80
Phelps Junction	85
Seneca Castle	252
Stanley	77
Victor	78
Orleans County:	
Oct.–Dec.—	
Albion	18
Ashwood	58
Brice	11

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

NEW YORK—Continued.

	Cars.
Orleans County—Contd.	
Oct.–Dec.—	
Carlton	5
Holley	3
Kendall	23
Knowlesville	1
Lydonville	7
Medina	71
Millers	4
Waterport	5
Oswego County:	
Aug.–Dec.—	
Furniss	2
New Haven	3
Phoenix	7
Otsego County:	
Oct. 1–Nov. 10—	
Fly Creek	1
International Siding	3
Oneonta	6
Otego	3
Schenevus	1
South Edmeston	2
Rensselaer County:	
Oct. 13–Dec.—	
Hoosick Falls	1
Rensselaer	1
Reynolds	4
Rockland County:	
Oct. 31–Nov. 16—	
Monsey	6
St. Lawrence County:	
Oct.—	
Helena	1
Schenectady County:	
Oct.–Nov.—	
Aqueduct	1
Hoffmans	3
Niskayuna	1
Schenectady	4
Schoharie County:	
Oct. 31—	
Middleburg	1
Seneca County:	
Sept. 21–Dec.—	
Junius	73
McDougall	3
Waterloo	3
Steuben County:	
Nov.–Mar.—	
Addison	1
Campbell	3
Corning	1
Hornell	1
Suffolk County:	
Sept. 8–Dec. 6—	
Bridgehampton	5
Greenlawn	34
Huntington	5
Kings Park	1
Miller's Place	2
Northport	33
Shelter Island	6
Wainscott	3
Tioga County:	
Oct. 3–Feb. 17—	
Nichols	1
Owego	8
Spencer	7
Tompkins County:	
Oct. 27–Dec. 10—	
Dryden	4
Groton	16
McLean	21
Ulster County:	
Nov.—	
Kingston	1
Wayne County:	
Sept.–Apr.—	
Alton	34
Clyde	10
East Palmyra	6

NEW YORK—Continued.

	Cars.
Wayne County—Contd.	
Sept.–Apr.—	
East Williamson	21
Fruitland	47
Lyons	144
Macedon	8
Marion	11
Newark	49
North Macedon	23
North Newark	4
North Rose	22
Ontario	45
Palmyra	27
Port Gibson	37
Red Creek	15
Savannah	25
Sodus	3
Sodus Center	24
Sodus Point	26
Walworth	5
Williamson	2
Wolcott	34
Westchester County:	
Nov.—	
Yorktown Heights	1
Wyoming County:	
Nov.–Mar.—	
Bliss	11
Eagle	2
Hardys	1
Pearl Creek	5
Yates County:	
Sept.–Jan.—	
Bellona	63
Benton	27
Branchport	1
Dundee	1
Penn Yan	3
Rushville	26
Starkey	2
N. Y., State total	6,260

NORTH CAROLINA.

Beaufort County:	
May 15–July 1:	
Washington	54
Carteret County:	
Mar. 2–May 26—	
Morehead City	76
Craven County:	
June 9–July 4—	
Newbern	125
Currituck County:	
June 13—	
Moyock	1
Edgecombe County:	
May 30—	
Conetoe	1
Henderson County:	
July 12–Aug. 8—	
Fletcher	1
Hendersonville	3
Lenoir County:	
Apr. 27–May 20—	
Kingston	1
Mitchell County:	
Oct. 4–27—	
Spruce Pine	3
Pamlico County:	
June 1–Aug. 1—	
Oriental	5
Surry County:	
Aug. 8–Oct. 25—	
Mt. Airy	65
Wayne County:	
May 17—	
Goldsboro	1
N. C., State total	336

NORTH DAKOTA.

	Cars.
Grand Forks County:	
Jan.—	
Grand Forks	1
N. Dak., State total	1

OHIO

Columbiana County:	
July—	
Lisbon	2
Cuyahoga County:	
June 15–Oct. 4—	
Cleveland	2
Erie County:	
Oct.—	
Huron	1
Parkerstown	5
Sandusky	2
Franklin County:	
July–Jan.—	
Columbus	4
Hamilton County:	
June 5–Aug. 11—	
Cincinnati	6
Newton	1
Hardin County:	
Aug. 23–Nov. 28—	
Ada	1
McGuffy	2
Huron County:	
Nov. 28—	
Monroeville	1
Lake County:	
Oct.—	
Perry	2
Lucas County:	
Sept. 12–Nov. 6—	
Neapolis	4
Toledo	1
Medina County:	
Aug. 7–Sept. 21—	
Lodi	14
Sandusky County:	
Aug.–Nov. 13—	
Clyde	13
Colby	11
Fremont	2
Helena	1
Seneca County:	
Aug. 25–Oct. 28—	
Green Springs	28
Old Fort	5
Washington County:	
June 24–July 26—	
Lowell	13
Marietta	3
Waterford	9
Wayne County:	
Sept. 3–Nov.—	
Funk	28
Wood County:	
Sept. 9–Nov. 8—	
Weston	26
Ohio, State total	187

OKLAHOMA.

Grady County:	
July 13—	
Chickasha	1
Le Flore County:	
June 9—	
Spiro	1
Pottawatomie County:	
Nov. 10—	
Shawnee	1
Okla., State total	3

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

	Cars.
OREGON.	
Multnomah County:	
Oct.–Mar.—	
East Portland	19
Portland	1
Troutdale	5
Oreg., State total	25
PENNSYLVANIA.	
Adams County:	
Oct.—	
Guernsey	2
Bradford County:	
Oct.—	
Wyalusing	1
Carbon County:	
Nov. 4—	
Weatherly	1
Columbia County:	
Oct. 3–14—	
Catawissa	4
Crawford County:	
Nov. 15—	
Spartansburg	1
Erie County:	
Oct. 1–Dec. 6—	
Mill Village	3
Waterford	86
Indiana County:	
Sept. 27–Oct. 6—	
Plumville	2
Jefferson County:	
Oct. 28–Nov. 9—	
Big Run	2
Punxsutawney	1
Lackawanna County:	
Oct. 23—	
Jermyn	1
Luzerne County:	
July 26–Nov. 20—	
Dallas	2
Fern Glen	1
Kingston	4
Montgomery County:	
Oct. 18—	
Ziegleysville	1
Philadelphia County:	
June 18–May 27—	
Philadelphia	26
Schuylkill County:	
Nov. 4–15—	
Brandonville	1
Ferndale	2
Ringtown	13
Somerset County:	
Sept. 30—	
Berlin	1
Susquehanna County:	
Nov. 1—	
Alford	1
Tioga County:	
Oct. 21–Dec. 10—	
Tioga Junction	4
Wayne County:	
Oct. 31–Nov. 8—	
Maplewood	2
Wyoming County:	
Nov. 2—	
Laceyville	1
York County:	
Sept.–Nov.	
Fawn Grove	4
Felton	3
Stewartstown	7
Turnpike	5
Pa., State total	182
RHODE ISLAND.	
Providence County:	
Aug. 25–Mar. 14—	
Providence	4
R. I., State total	4
SOUTH CAROLINA.	
Charleston County:	
Apr. 26–June 29—	
Charleston	957
Meggett	50
Yonge's Island	3
Georgetown County:	
May 8—	
Georgetown	1
S. C., State total	1,011
SOUTH DAKOTA.	
Minnehaha County:	
Oct. 24–Nov. 7—	
Ellis	1
Sioux Falls	1
S. Dak., State total	2
TENNESSEE.	
Davidson County:	
July 1–14—	
Nashville	3
Gibson County:	
May 27–July 1—	
Gibson	42
Humboldt	29
Weakley County:	
July—	
Martin	11
Tenn., State total	85
TEXAS.	
Cameron County:	
Jan.–May—	
Brownsville	133
Harlingen	43
La Feria	3
Rio Hondo	5
San Benito	240
Chambers County:	
Jan. 20–June 13—	
Stowell	7
Dimmit County:	
June–July—	
Carrizo Springs	3
El Paso	1
Hidalgo County:	
Jan. 29–May 10—	
Donna	12
Edinburg	7
McAllen	25
Mercedes	105
Mission	400
Pharr	15
San Juan	5
Nueces County:	
Feb. 23–Apr. 8—	
Calallen	3
Corpus Christi	19
Smith County:	
Mar.—	
Tyler	1
Walker County:	
May 15–27—	
Dodge	2
Webb County:	
Jan. 1–Mar. 8—	
Laredo	86
Tex., State total	1,115
UTAH.	
Cache County:	
Jan. 25—	
Logan	1
Morgan County:	
Jan. 15—	
Morgan	1
Sanpete County:	
Oct.—	
Ephraim	1
Moroni	3
Weber county:	
Aug. 8—	
Ogden	1
Utah, State total	7
VERMONT.	
Bennington County:	
Oct. 14–Nov. 9—	
North Bennington	7
South Shaftsbury	2
Chittenden County:	
Dec. 10—	
Burlington	1
Vt., State total	10
VIRGINIA.	
Accomac County:	
June 1–July 15—	
Bloxom	8
Hallwood	2
Keller	2
Melfa	1
Onley	2
Painter	2
Augusta County:	
Aug. 12—	
Staunton	2
Bedford County:	
June 20—	
Forest	1
Dinwiddie County:	
June 26–July 7—	
Petersburg	1
Elizabeth City County:	
May 18–Nov. 16—	
Old Point Comfort	17
Hanover County:	
June 17–July 5—	
East Atlee	2
Old Church	1
Henrico County:	
May 31–June 19—	
Richmond	2
King William County:	
June 9–29—	
West Point	2
Norfolk County:	
May 8–Dec. 22—	
Fentress	1
Norfolk	1,723
Port Norfolk	381
Portsmouth	20
Northampton County:	
May 20–July 15—	
Bay View	46
Birds Nest	12
Cape Charles	216
Capeville	3
Cheriton	35
Cobbs	59
Eastville	88
Exmore	4
Kendall Grove	6
Machipongo	15
Nassawadox	6
Plantation	1
Townsend	4
Wierwood	12

BRASSICAS—Continued.

Table 60.—CABBAGES—Continued.

VIRGINIA—Continued.

	Cars.
Patrick County:	
Sept. 1–Dec. 31—	
Stuart	10
Princess Anne County:	
May 17–June 24—	
Kempsville	37
London Bridge	5
Virginia Beach	3
Smyth County:	
July 22–Nov. 8—	
Atkins	79
Groseclose	60
Marion	86
Seven Mile Ford	11
Wythe County:	
July 4–Nov. 2—	
Crockett	117
Rural Retreat	185
Speedwell	1
May–July:	
Occohannock River landings	15
June–Nov.:	
Piankatank River landings	1
June–Nov.:	
Rappahannock River landings	2
Va., State total	3,289

WASHINGTON.

King County:	
Oct.–Jan.—	
Auburn	3
Kent	6
Seattle	10
Pierce County:	
Nov. 28—	
Tacoma	1
Spokane County:	
Oct.–Jan.—	
Hillyard	5
Spokane	3
Yardley	1
Walla Walla County:	
June 17–July 26—	
Walla Walla	25
Whitman County:	
Sept. 21–Nov. 3—	
Colfax	1
Garfield	1
Yakima County:	
July–Jan.—	
North Yakima	3
Wash., State total	59

WEST VIRGINIA.

Wood County:	
Nov.–Jan.—	
Parkersburg	3
Williamstown	7
W. Va., State total	10

WISCONSIN.

	Cars.
Ashland County:	
Oct. 23—	
Ashland	1
Barron County:	
Oct. 3–17—	
Almena	9
Comstock	5
Rice Lake	1
Brown County:	
Aug. 15–Dec. 14—	
Big Suamico	6
De Pere	30
Green Bay	89
Chippewa County:	
Oct.–Jan.—	
Cotten	17
Stanley	30
Columbia County:	
Oct.–Jan.—	
Cambria	82
Friesland	10
Dane County:	
Oct. 26—	
Morrisonville	1
Dodge County:	
Oct.–Jan.—	
Chester	1
Lomira	7
Randolph	4
Dunn County:	
Oct. 31—	
Elk Mound	1
Eau Claire County:	
Sept. 8–Jan.—	
Allen	2
Cleghorn	2
Eau Claire	10
Fall Creek	7
Foster	2
Fond du Lac County:	
Aug. 30–Jan.—	
Ripon	142
Waupun	29
Jackson County:	
Oct. 19—	
Alma Center	1
Kenosha County:	
Aug.–Jan.—	
Berryville	210
Bristol	8
Kenosha	96
Pleasant Prairie	22
Salem	7
Somers	462
Trevor	20
Woodworth	6
La Crosse County:	
Sept. 27–Oct. 3—	
La Crosse	1
Onalaska	5
Manitowoc County:	
Sept. 10–24—	
Manitowoc	5
Marathon County:	
Oct. 16—	
Wausau	1
Milwaukee County:	
Sept.–Mar.—	
Brown Deer	13
Cudahy	14

WISCONSIN—Continued.

	Cars.
Milwaukee County—Contd.	
Sept.–Mar.—	
Milwaukee	1
Oakwood	53
South Milwaukee	24
Wauwatosa	5
Outagamie County:	
Sept.–Feb. 15—	
Appleton	349
Appleton Junction	63
Bear Creek	49
Black Creek	62
Greenville	127
Hortonville	53
Little Chute	1
Medina	14
Seymour	12
Shiocton	659
Pierce County:	
Sept. 9–Nov. 26—	
Beldenville	5
River Fall	49
Racine County:	
Sept.–Jan.—	
Caledonia	120
Corliss	503
Dover	4
Frankville	81
Kansasville	36
Racine	101
Racine Junction	8
Union Grove	162
Rock County:	
Sept. 14–Jan.—	
Beloit	45
Clinton	9
Janesville	4
Shawano County:	
Oct. 1–Nov. 30—	
Green Valley	2
Pulaski	10
Split Rock	1
Sheboygan County:	
Oct. 28—	
Random Lake	1
Walworth County:	
Sept. 16–Jan. 20—	
Darien	3
Genoa Junction	97
Washburn County:	
Oct. 13–18—	
Sarona	1
Trego	1
Washington County:	
Oct. 1–31—	
Colgate	3
Waukesha County:	
Nov. 15—	
Eagle	1
Waupaca County:	
Nov. 10–Dec. 15—	
New London	3
Winnebago County:	
Oct.—	
Neenah	3
State Hospital	1
Wood County:	
Oct. 15–Nov. 10—	
Marshfield	3
Wis., State total	4,088

Table 61.—CAULIFLOWER.

CALIFORNIA.

	Cars.
Alameda County:	
Feb. 26–Mar. 19—	
Decoto	9
Lorenzo	7
Oakland	6

CALIFORNIA—Continued.

	Cars.
Los Angeles County:	
Oct.–June—	
Airville	1
Arcadia	1
Artesia	2

CALIFORNIA—Continued.

	Cars.
Los Angeles County—Contd.	
Oct.–June—	
Bandini	2
Cienega	15
Clearwater	3

BRASSICAS—Continued.

Table 61.—CAULIFLOWER—Continued.

CALIFORNIA—Continued.

	Cars.
Los Angeles County—Con.	
Oct.-June—	
Clement Junction	1
Compton	320
Downey	21
El Monte	19
Florence	180
Hobart	5
Home Junction	1
Kester	1
Los Angeles	155
Mount Olivet	8
Newark	7
Rivera	7
San Gabriel	1
San Pedro	30
Saugus	6
Tropico	1
Vernondale	24
Watts	172
Orange County:	
Mar. 17—	
La Habra	1
Sacramento County:	
Feb. 16–Mar. 9—	
Sacramento	5
San Francisco County:	
Nov.-June—	
San Francisco	35
San Joaquin County:	
Oct. 26–Dec. 13—	
Stockton	1
San Mateo County:	
Sept.-June—	
Colma	241
Millbrae	7
Race Track Junction	13
San Bruno	14
Santa Clara County:	
Dec. 24–Mar. 7—	
Milpitas	4
Cal., State total	1,326

COLORADO.

	Cars.
Denver County:	
Sept. 10–Oct. 14—	
Burnham	1
Denver	2
Colo., State total	3

ILLINOIS.

Cook County:	
June 26–Dec. 11—	
Chicago	4
Ill., State total	4

KENTUCKY.

Jefferson County:	
June 7–24—	
Louisville	2
Ky., State total	2

LOUISIANA.

Iberville Parish:	
Jan. 1–31—	
White Castle	20
La., State total	20

MARYLAND.

Nov.—	
Choptank River landings	1
Md., State total	1

NEW YORK.

	Cars.
Delaware County:	
Aug. 11–Nov. 3—	
Arena	4
Dunraven	10
Margaretville	18
Erie County:	
Oct. 2–Dec. 2—	
Buffalo	4
Orchard Park	161
Suffolk County:	
Aug.-Jan.—	
Aquebogue	6
Calverton	208
Cutchogue	48
Greenport	7
Jamesport	65
Manorville	11
Mattituck	61
Orient	3
Peconic	150
Riverhead	514
Shelter Island	24
Southold	189
N. Y., State total	1,483

PENNSYLVANIA.

Philadelphia County:	
Sept.-June—	
Philadelphia	23
Pa., State total	23

VIRGINIA.

Norfolk County:	
May 5–June 14—	
Norfolk	10
Va., State total	10

Table 62.—KALE.

FLORIDA.

	Cars.
Polk County:	
Jan. 1–Feb. 1—	
Bartow	5
Fla., State total	5

MARYLAND.

Baltimore City:	
Feb.—	
Baltimore	7
Md., State total	7

VIRGINIA.

	Cars.
Elizabeth City County:	
Oct. 10–Nov. 21—	
Old Point Comfort	1
Norfolk County:	
Oct. 9–June 1—	
Norfolk	2,437
Port Norfolk	113
Portsmouth	6
Princess Anne County:	
Oct.—	
London Bridge	10
Va., State total	2,567

SALAD CROPS.

Table 63.—CELERY.

CALIFORNIA.

	Cars.
Contra Costa County:	
Oct. 19–Mar. 21—	
Antioch	1,269
Orwood	3
Los Angeles County:	
Sept.-July—	
Almitos Beach	6
Compton	4
Downey	4
El Monte	514
Florence	1

CALIFORNIA—Continued.

	Cars.
Los Angeles County—Con.	
Sept.-July—Continued.	
Gardena	3
Los Angeles	118
Newmark	2
Pico	39
Rivera	1
San Gabriel	3
San Pedro	2
Vernondale	13
Watts	7

CALIFORNIA—Continued.

	Cars.
Monterey County:	
Dec. 13—	
Watsonville Junction	1
Orange County:	
Nov.-Mar.—	
Garden Grove	1
Huntington Beach	9
La Bolsa	5
Los Alamitos	7
Santa Ana	50
Tustin	1

SALAD CROPS—Continued.

Table 63.—CELERY—Continued.

CALIFORNIA—Continued.

	Cars.
Sacramento County:	
Oct. 13–Feb. 9—	
Sacramento	7
Walnut Grove	376
San Francisco County:	
Mar. 2–17—	
San Francisco	5
San Joaquin County:	
Oct.–June—	
Holt	85
Stockton	5
San Mateo County:	
Dec. 9—	
Colma	1
Santa Clara County:	
Oct.–Nov.—	
Palo Alto	2
San Jose	1
Cal., State total	2,545

COLORADO.

Adams County:	
Oct. 12–Oct. 29—	
Brighton	6
Arapahoe County:	
Oct. 17–Nov. 4—	
Petersburg	6
Denver County:	
Aug. 5–Nov. 2—	
Denver	249
Pueblo County:	
Sept. 15–Oct. 2—	
Pueblo	2
Weld County:	
Sept. 12–Nov. 4—	
Ione	4
Milliken	1
Traceyville	1
Wattenberg	101
Colo., State total	370

FLORIDA.

Hillsborough County:	
Jan. 5–May 30—	
Plant City	2
Tampa	172
Wimauma	8
Ybor City	77
Manatee County:	
Jan.–May—	
Elenton	14
Manatee	8
Oneco	189
Palmetto	3
Parish	175
Terra Ceia	15
Orange County:	
Feb. 3—	
Orlando	1
Polk County:	
Feb.—	
Lakeland	12
Seminole County:	
Jan. 15–June 15—	
Sanford	2,326
Fla., State total	3,002

IDAHO.

Ada County:	
Oct. 19–Dec. 2—	
Boise	13
Idaho, State total	13

ILLINOIS.

Cook County:	
Aug. 6–July 16—	
Chicago	11
Ill., State total	11

INDIANA.

Dekalb County:	
Dec.—	Cars.
Waterloo	5
Ind., State total	5

MARYLAND.

Baltimore City:	
Oct. 5–Apr. 26—	
Baltimore	22
Carroll County:	
Sept. 1–Oct. 30—	
Asbestos	6
Md., State total	28

MICHIGAN.

Allegan County:	
Dec.—	
Dorr	8
Cass County:	
Oct.–Nov.—	
Glenwood	21
Kalamazoo County:	
Aug. 1–Nov.—	
Comstock	41
Kalamazoo	398
Portage	167
Kent County:	
Nov.–Dec.—	
Byron Center	9
Grand Rapids	2
Ross	2
Lenawee County:	
Sept.–Dec.—	
Onsted	1
Tecumseh	44
Tecumseh Junction	37
Tipton	15
Muskegon County:	
June 13–Nov. 12—	
Montague	5
Muskegon	813
Whitehall	3
Ottawa County:	
June 23–Dec. 5—	
Grand Haven	331
Van Buren County:	
Oct.–Nov.—	
Decatur	250
Washtenaw County:	
Oct.—	
Manchester	17
Mich., State total	2,164

NEBRASKA.

Hall County:	
Oct.—	
Grand Island	1
Nebr., State total	1

NEW JERSEY.

Hudson County:	
Dec.—	
Weehawken	1
Warren County:	
July 20–Oct. 21—	
Alphano	5
Great Meadows	89
N. J., State total	95

NEW YORK.

Allegany County:	
Oct. 16–Dec. 9—	
Burns	12
Cattaraugus County:	
Aug. 18–Dec. 31—	
Conewango	5

NEW YORK—Continued.

Cayuga County:	
Sept.–Dec.—	Cars.
Crockett	2
Ira	1
Port Byron	37
Chautauqua County:	
Nov. 1—	
Jamestown	1
Genesee County:	
Nov.–Dec. 23—	
East Bethany	5
Elba	20
Le Roy	4
North Bergen	7
Livingston County:	
Aug. 7–Nov.—	
Caledonia	1
Livonia	18
South Lima	132
Madison County:	
Oct.—	
Canastota	1
North Chittenango	2
Monroe County:	
Oct.–Jan.—	
Barnard	17
Brockport	3
Fairport	14
Henrietta	4
Hilton	7
Mumford	9
Rochester	66
Union Hill	14
Uptonville	40
Wayneport	5
Webster	15
West Henrietta	1
Oneida County:	
Oct.–Dec.—	
Rome	5
Onondaga County:	
Oct.–Dec.—	
Jordan	4
Syracuse	14
Ontario County:	
Oct.–Jan.—	
Aloquin	3
Canandaigua	3
Farmington	4
Geneva	22
Holcomb	23
Phelps Junction	1
Seneca Castle	3
West Bloomfield	13
Orange County:	
Aug. 2–Dec. 11—	
Lake	1
Middletown	47
New Hampton	7
Pine Island	40
Vails Gate Junction	1
Orleans County:	
Oct.–Dec.—	
Albion	3
Holley	2
Medina	8
Oswego County:	
Oct. 4–Feb. 1—	
Central Square	10
Fulton	58
Furniss	4
Oswego	4
Seneca County:	
Oct.–Nov.—	
McDougall	6
Waterloo	17
Steuben County:	
Sept. 20–Nov. 24—	Cars.
Arkport	71
Wayland	3

SALAD CROPS—Continued.

Table 63.—CELERY—Continued.

NEW YORK—Continued.

	Cars.
Suffolk County:	
Nov. 8–22—	
Orient	2
Wayne County:	
Sept.–Dec.—	
Clyde	7
East Williamson	55
Fruitland	31
Lyons	87
Macedon	46
Marion	34
Newark	12
North Macedon	1
North Newark	15
North Rose	88
Ontario	71
Palmyra	2
Red Creek	53
Sodus	53
Sodus Center	7
Williamson	241
Wolcott	33
N. Y., State total	1,658

OHIO.

	Cars.
Cuyahoga County:	
Sept.—	
Cleveland Pier	1
Medina County:	
July 24–Oct. 7—	
Lodi	28
Portage County:	
Sept. 19–Nov. 30—	
Kent	2
Stark County:	
Sept. 15–Nov. 27—	
Hartville	2
Ohio, State total	33

OREGON.

Multnomah County:	
Dec. 28—	
East Portland	1
Oreg., State total	1

PENNSYLVANIA.

	Cars.
Allegheny County:	
June 27–Dec. 30—	
Allegheny	9
Philadelphia County:	
Aug. 15–Oct. 31—	
Philadelphia	80
Tioga County:	
Sept.–Nov.—	
Wellsboro Junction	177
Pa., State total	266

TEXAS.

Dallas County:	
Jan.–Feb.—	
Dallas	2
Tex., State total	2

WISCONSIN.

Racine County:	
Dec. 12–29—	
Racine	1
Wis., State total	1

Table 64.—LETTUCE.

ARIZONA.

	Cars.
Maricopa County:	
Jan. 27–Apr. 30—	
Glendale	10
Phoenix	7
Ariz., State total	17

CALIFORNIA.

Alameda County:	
May 16–20—	
Alameda	2
Imperial County:	
Feb. 18–Mar. 29—	
Brawley	7
Heber	16
Los Angeles County:	
Sept. 23–Apr. 28—	
Bandini	33
Bergamot	8
Central Avenue	34
Compton	8
Downey	1
El Monte	39
Florence	2
Gardena	12
Glendale	2
Hobart	10
Home Junction	18
Hynes	7
Inglewood	6
Kester	6
Long Beach	4
Los Angeles	597
Los Nietos	6
Mount Olivet	7
Newmark	77
Palms	7
Puente	6
Rivera	43
Rosco	1
Rosemead	2
Rowland	1
San Gabriel	69
San Marino	1
Santa Fe Springs	4
Saugus	1
Tropico	12
Van Nuys	3
Vernondale	68
Watts	25

CALIFORNIA—Continued.

	Cars.
Orange County:	
Apr. 25—	
El Modena	1
Sacramento County:	
Oct. 23–May 27—	
Sacramento	52
San Francisco County:	
Aug. 9–Jan. 14—	
San Francisco	24
San Mateo County:	
Aug. 19–Sept. 28—	
Colma	22
Cal., State total	1,244

COLORADO.

Denver County:	
June 29–Nov. 3—	
Denver	22
Weld County:	
Nov. 2–Dec. 2—	
Wattenberg	2
Colo., State total	24

FLORIDA.

Alachua County:	
Dec. 16–Apr. 30—	
Clyatt	46
Evinston	2
Kirkwood	1
Micanopy	19
Rocky Point	6
Hillsborough County:	
Jan.—	
Ybor City	1
Manatee County:	
Jan.–Mar.	
Ellenton	34
Parish	13
Terra Ceia	3
Marion County:	
Jan. 1–Apr. 1—	
Anthony	5
Hickman	2
Orange Lake	16
South Side	34
Sparr	5

FLORIDA—Continued.

	Cars.
Orange County:	
Dec. 15–Apr. 15—	
Oakland	81
Tildenville	17
Winter Garden	185
Polk County:	
Dec.–Mar. 13—	
Bartow	65
Seminole County:	
Dec.–Apr. 6—	
Sanford	993
Fla., State total	1,528

ILLINOIS.

Cook County:	
Dec.–Mar.—	
Chicago	25
St. Clair County:	
May 18–20—	
East St. Louis	2
Ill., State total	27

IOWA.

Scott County:	
May 25—	
Davenport	1
Iowa, State total	1

LOUISIANA.

Orleans Parish:	
Feb. 15–May 30—	
New Orleans	12
Ouachita Parish:	
May 5—	
Monroe	1
La., State total	13

SALAD CROPS—Continued.

Table 64.—LETTUCE—Continued.

MARYLAND.

	Cars.
Baltimore City:	
Nov. 8–June 10—	
Baltimore	4
Md., State total	4

MASSACHUSETTS.

Suffolk County:	
Dec.—	
Boston	1
Mass., State total	1

MICHIGAN.

Muskegon County:	
June 16–Nov. 9—	
Muskegon	13
Oakland County:	
Sept. 30—	
Holly	1
Mich., State total	14

MINNESOTA.

St. Louis County:	
June–Nov.—	
Duluth	21
Minn., State total	21

MISSISSIPPI.

Holmes County:	
May 3—	
Durant	1
Miss., State total	1

MISSOURI.

St. Louis City:	
May 18—	
St. Louis	1
Mo., State total	1

NEW JERSEY.

Cumberland County:	
May 25–Oct. 14—	
Cedarville	5
Newport	2
South Vineland	4
Warren County:	
June 24–Oct. 19—	
Great Meadows	77
N. J., State total	88

NEW YORK.

Cattaraugus County:	
Aug.—	
Conewango	5
Cayuga County:	
Nov.—	
Port Byron	3
Erie County:	
Aug.–Nov. 2—	
Buffalo	1
Orchard Park	1

NEW YORK—Continued.

	Cars.
Genesee County:	
Aug. 1–Nov.—	
Batavia	15
Elba	197
Livingston County:	
July 17—	
South Lima	1
Monroe County:	
Oct.–Nov.—	
Hilton	2
Rochester	1
Webster	2
Oneida County:	
Sept.–Oct.—	
Rome	5
Orange County:	
July 10–Sept. 28—	
East Chester	10
Middletown	3
Orleans County:	
Aug. 16–Nov.—	
Albion	3
Fancher	104
Holley	4
Kendall	2
Medina	17
Oswego County:	
July 19–Nov.—	
Fulton	406
Furniss	1
Seneca County:	
Sept.–Oct.—	
Waterloo	2
Steuben County:	
Aug. 14—	
Wayland	1
Wayne County:	
July 20–Dec.—	
East Williamson	88
Fruitland	3
Marion	15
North Rose	7
Ontario	16
Sodus	69
Sodus Center	6
Williamson	69
Wyoming County:	
Aug. 1–Oct. 15—	
Gainesville	3
N. Y., State total	1,062

NORTH CAROLINA.

New Hanover County:	
Apr. 3–Nov. 20—	
Castle Hayne	25
Wilmington	58
N. C., State total	83

OHIO.

Ashtabula County:	
Jan. 8–Mar. 10—	
Ashtabula	75
Hamilton County:	
July 15—	
Cincinnati	1
Wayne County:	
July 3–26—	
Funk	2
Ohio, State total	78

OREGON.

	Cars.
Multnomah County:	
Mar. 30–Dec. 20—	
East Portland	2
Portland	1
Oreg., State total	3

PENNSYLVANIA.

Philadelphia County:	
Aug. 15–Oct. 31—	
Philadelphia	63
Tioga County:	
Aug. 1–Oct.—	
Elkland	2
Wellsboro Junction	46
Pa., State total	111

SOUTH CAROLINA.

Beaufort County:	
Feb. 10–April 30—	
Beaufort	14
Port Royal	96
Sheldon	1
Charleston County:	
Apr. 4–22—	
Charleston	21
S. C., State total	132

TEXAS.

Cameron County:	
Jan. 1–Mar. 25—	
Brownsville	2
San Benito	63
Dimmit County:	
Feb.—	
Carrizo Springs	4
Hidalgo County:	
Feb.—	
Mission	6
Lasalle County:	
Jan. 10–Mar. 25—	
Cotulla	24
Fowlerton	8
Tarrant County:	
June 7–Aug. 28—	
Fort Worth	7
Webb County:	
Jan. 4–Mar. 1—	
Laredo	8
Tex., State total	122

VIRGINIA.

Elizabeth City County:	
May 8–Nov. 28—	
Old Point Comfort	16
Norfolk County:	
May 1–Nov. 27—	
Norfolk	106
Port Norfolk	1
Portsmouth	1
Va., State total	124

WASHINGTON.

King County:	
Aug. 7—	
Seattle	1
Wash., State total	1

SALAD CROPS—Continued.

Table 65.—PARSLEY.

LOUISIANA.

	Cars.
Orleans Parish:	
Apr. 26–May 26—	
New Orleans	5
La., State total	5

PENNSYLVANIA.

	Cars.
Philadelphia County:	
Nov.—	
Philadelphia	1
Pa., State total	1

VIRGINIA.

	Cars.
Norfolk County:	
Oct.–June—	
Norfolk	12
Va., State total	12

PERENNIALS.

Table 66.—ARTICHOKES.

CALIFORNIA.

	Cars.
Contra Costa County:	
Nov. 17–Jan. 19—	
Antioch	6
San Francisco County:	
Nov.–June 16—	
San Francisco	244

CALIFORNIA—Continued.

	Cars.
San Mateo County:	
Feb. 16–May 20—	
Colma	24
Half Moon	13
Salada	19
Cal., State total	306

PENNSYLVANIA.

	Cars.
Philadelphia County:	
Dec.—	
Philadelphia	1
Pa., State total	1

Table 67.—ASPARAGUS.

CALIFORNIA.

	Cars.
Alameda County:	
Mar. 2–Apr. 7—	
Lorenzo	6
Contra Costa County:	
Mar. 22–May 19—	
Antioch	204
Oakley	117
Orwood	17
Imperial County:	
Mar. 9–Apr. 30—	
Imperial	29
Sacramento County:	
Mar. 11–Apr. 21—	
Sacramento	75
Walnut Grove	115
San Francisco County:	
Mar. 2–Apr. 20—	
San Francisco	59
Cal., State total	622

ILLINOIS.

	Cars.
Jackson County:	
Apr. 4–June 1—	
Makanda	8
La Salle County:	
May 4–30—	
Ottawa	41
Madison County:	
May 6–June 6—	
Godfrey	28
Union County:	
Apr. 17–June 12—	
Cobden	65
Ill., State total	142

MARYLAND.

	Cars.
May–July—	
Chester River landings	12
May—	
Choptank River landings	1

MARYLAND—Continued.

	Cars.
May:	
Wicomico River landings	1
Md., State total	14

MASSACHUSETTS.

	Cars.
Barnstable County:	
May 19–22—	
North Eastham	1
Mass., State total	1

MICHIGAN.

	Cars.
Muskegon County:	
June 23—	
Muskegon	1
Mich., State total	1

NEW JERSEY.

	Cars.
Camden County:	
June 2—	
Elm	1
Cumberland County:	
May 15–July 13—	
Bridgeton	8
Greenwich	33
Greenwich Pier	38
Gloucester County:	
May 13–July 1—	
Richwood	38
Swedesboro	15
Monmouth County:	
May 15–July 13—	
Freehold	53
Keansburg	16
Marlboro	39
Port Monmouth	41

NEW JERSEY—Continued.

	Cars.
Monmouth County—Con.	
May 15–July 13—	
Red Bank	117
Wickatunk	4
N. J., State total	403

PENNSYLVANIA.

	Cars.
Bucks County:	
Apr. 29–July 5—	
Tullytown	40
Pa., State total	40

SOUTH CAROLINA.

	Cars.
Barnwell County:	
Apr. 3–May 10—	
Williston	22
Charleston County:	
Apr. 3–May 5—	
Charleston	12
Saluda County:	
Apr. 3–21—	
Ridge Spring	9
S. C., State total	43

VIRGINIA.

	Cars.
Norfolk County:	
May 21–24—	
Norfolk	1
May–June—	
Rappahannock River landings	4
Va., State total	5

WASHINGTON.

	Cars.
Walla Walla County:	
July 10—	
Walla Walla	1
Wash., State total	1

PERENNIALS—Continued.

Table 68.—RHUBARB.

CALIFORNIA.

	Cars.
Alameda County:	
Mar. 3–Apr. 20—	
Hayward	3
Lorenzo	134
San Leandro	5
Los Angeles County:	
Nov. 14—	
Pico	1
San Francisco County:	
Mar. 16–28—	
San Francisco	3
Cal., State total	146

CONNECTICUT.

New Haven County:	
May 15–23—	
New Haven	4
Conn., State total	4

ILLINOIS.

	Cars.
Cook County:	
Apr. 28—	
Chicago	1
Jackson County:	
Apr. 4—	
Makanda	4
Kankakee County:	
May 6–May 17—	
Kankakee	5
Union County:	
Apr. 22–June 12—	
Alto Pass	42
Anna	3
Cobden	47
Ill., State total	102

INDIANA.

Vigo County:	
May 11—	
Terre Haute	1
Ind., State total	1

OREGON.

	Cars.
Clackamas County:	
May 16–Aug. 5	
Canby	3
Umatilla County:	
May 15–Aug. 5—	
Freewater	1
Oreg., State total	4

WASHINGTON.

Walla Walla County:	
May–June—	
Walla Walla	13
Wash., State total	13

PULSE CROPS.

Table 69.—GREEN LIMA BEANS.

FLORIDA.

	Cars.
Hillsborough County:	
Apr.–May—	
Plant City	10
Fla., State total	10

ILLINOIS.

Vermilion County:	
Aug.—	
Westville	1
Ill., State total	1

NEW JERSEY.

	Cars.
Cumberland County:	
July 20–Oct.—	
Greenwich	1
Leesburg	10
Mauricetown	2
Port Norris	17
N. J., State total	30

NEW YORK.

	Cars.
New York County:	
June 26–Nov. 27—	
New York	5
Richmond County:	
Apr. 20–Aug. 24—	
St. George Lighterage	2
Suffolk County:	
June–Sept.—	
Peconic	150
N. Y., State total	157

Table 70.—STRING BEANS.

ALABAMA.

	Cars.
Autauga County:	
Oct. 1—	
Billingsley	1
Mobile County:	
May 11–31—	
Mobile	26
Tacon	1
Theodore	1
Sumter County:	
May 17–July 10:	
Cuba	8
York	3
Ala., State total	40

CONNECTICUT.

New Haven County:	
July 5—	
New Haven	1
Conn., State total	1

DELAWARE.

Sussex County:	
Oct. 7—	
Lincoln City	1
Del., State total	1

FLORIDA.

	Cars.
Alachua County:	
May 1–30—	
Clyatt	40
Evinston	17
Flewellen	1
Gainesville	5
Lisman	1
Micanopy	6
Rocky Point	1
Wacahoota	4
De Soto County:	
May 9–21—	
Bowling Green	4
Fort Green	3
Fort Green Springs	2
Wauchula	16
Zolfo	1
Gadsden County:	
Oct. 10–26—	
Quincy	7
Hillsborough County:	
Apr. 5–May 30—	
Plant City	2
Marion County:	
May–June—	
Ocala	9
Orange Lake	2
Reddick	3
Santos	1
Simonton	2
South Side	5

FLORIDA—Continued.

	Cars.
Polk County:	
May 13–18—	
Bartaw	2
Putnam County:	
Oct. 10–14—	
Grandin	2
Seminole County:	
May 1–30—	
Sanford	29
Sumter County:	
Apr.–May—	
Linden	2
Webster	11
Fla., State total	178

GEORGIA.

Chatham County:	
May—	
Savannah	4
Ga., State total	4

ILLINOIS.

Cook County:	
June 19–Nov. 20—	
Chicago	12
Pulaski County:	
June 22–July 8—	
Villa Ridge	6

PULSE CROPS—Continued.

Table 70.—STRING BEANS—Continued.

	Cars.
ILLINOIS—Continued.	
Union County:	
July 1—	
Mill Creek	1
Ill., State total	19
KENTUCKY.	
Jefferson County:	
June 14–15—	
Louisville	2
Ky., State total	2
LOUISIANA.	
Orleans Parish:	
Apr. 26–June 14—	
New Orleans	30
Tangipahoa Parish:	
May 20—	
Roseland	1
La., State total	31
MARYLAND.	
Baltimore City:	
June 8–Oct. 7—	
Baltimore	321
Somerset County:	
May 24–Aug. 4—	
Eden	17
Kings Creek	2
Loretto	3
Princess Anne	13
Westover	1
Wicomico County:	
June 1–Aug. 10—	
Fruitland	2
Aug. 31–Nov. 1—	
Choptank River landings	9
July–Oct. 14—	
Wicomico River landings	6
Md., State total	374
MASSACHUSETTS.	
Suffolk County:	
Aug. 15—	
Boston	1
Mass., State total	1
MICHIGAN.	
Kent County:	
Aug. 30—	
Grand Rapids	31
Lapeer County:	
Aug. 1–15—	
Clifford	2
Montcalm County:	
May 17—	
Pierson	1
Six Lakes	1
Ottawa County:	
July 5–18—	
Grand Haven	5
Van Buren County:	
July 27–Aug. 24—	
South Haven	1
Mich., State total	41
MISSISSIPPI.	
Copiah County:	
May 12–June 17—	
Crystal	98
Gallman	6
Georgetown	3
Hazlehurst	25
Hopewell	6
Walthall County:	
May 16–25—	
Tylertown	3
Wilkinson County:	
May 27—	
Centerville	1
Miss., State total	142
MISSOURI.	
St. Louis City:	
June—	
St. Louis	1
Mo., State total	1
NEW JERSEY.	
Atlantic County:	
June 30—	
Landisville	1
Burlington County:	
June 27–Sept. 22—	
Beverly	3
Delanco	1
Edgewater Park	20
Riverton	2
Camden County:	
July 24—	
Elm	1
Cumberland County:	
June 21–Oct. 14—	
Bridgeton	6
Cedarville	27
Fairton	5
Greenwich	12
Newport	236
Port Norris	20
South Vineland	20
Salem County:	
July 7–Oct. 9—	
Norma	32
N. J., State total	386
NEW YORK.	
Chautauqua County:	
July 30–Aug. 15—	
Irving	5
Erie County:	
Aug. 1–Sept. 23—	
Angola	40
Buffalo	7
East Aurora	2
North Collins	8
Genesee County:	
May 27—	
East Bethany	1
Kings County:	
Aug. 18—	
Brooklyn	3
Livingston County:	
July—	
Lima	3
New York County:	
June 15–Oct. 31—	
New York	12
Wyoming County:	
July—	
Gainesville	5
Yates County:	
July—	
Starkey	1
N. Y., State total	87
NORTH CAROLINA.	
Duplin County:	
June 3–14—	
Faison	6
New Hanover County:	
May 26–June 16—	
Wilmington	36
Pender County:	
May 26–June 16—	
Rocky Point	23
Wayne County:	
May 27–June 17—	
Dudley	5
Goldsboro	37
Mt. Olive	20
Pikeville	1
N. C., State total	128
PENNSYLVANIA.	
Philadelphia County:	
June 28–July 1—	
Philadelphia	2
York County:	
June—	
Red Lion	4
Pa., State total	6
SOUTH CAROLINA.	
Charleston County:	
Apr. 17–June 14—	
Charleston	165
John's Island	1
St. Andrews	35
Florence County:	
May 1–June 1—	
Lake City	26
Williamsburg County:	
Apr. 8–June 7—	
Cades	17
Gourdins	1
Kingstree	6
Lanes	1
S. C., State total	252
TENNESSEE.	
Davidson County:	
June 17–27—	
Nashville	2
Gibson County:	
June 12–13—	
Humboldt	1
Tenn., State total	3
TEXAS.	
Cameron County:	
Apr. 15–May 11—	
Brownsville	3
San Benito	16
Dallas County:	
June–Nov.—	
Dallas	2
Tex., State total	21
VERMONT.	
Grand Isle County:	
Aug. 15–Oct. 1—	
Isle La Motte Station	5
Vt., State total	5

PULSE CROPS—Continued.

Table 70.—STRING BEANS—Continued.

VIRGINIA.

	Cars.
Elizabeth City County:	
June 8–Oct. 7—	
Old Point Comfort	6
Norfolk County:	
May 4–Nov. 10—	
Norfolk	935
Port Norfolk	14
Portsmouth	12

VIRGINIA—Continued.

	Cars.
Northampton County:	
June 1–Oct. 15—	
Cheriton	4
Roanoke County:	
June—	
East Roanoke	8

VIRGINIA—Continued.

	Cars.
York County:	
June 8–22—	
Yorktown	4
Va., State total	983

Table 71.—GREEN PEAS.

ALABAMA.

	Cars.
Barbour County:	
Mar.—	
Eufaula	3
Houston County:	
Mar.—	
Columbia	1
Ala., State total	4

CALIFORNIA.

Contra Costa County:	
July 18—	
Whitman	1
Imperial County:	
Mar. 14–May 25—	
Brawley	11
Heber	1
Los Angeles County:	
Mar. 24—	
San Gabriel	1
Sacramento County:	
Apr. 21—	
Walnut Grove	1
San Francisco County:	
Apr. 8–Nov. 20—	
San Francisco	18
San Mateo County:	
Apr. 28—	
Colma	1
Santa Cruz County:	
Sept. 20–29—	
Watsonville	5
Cal., State total	39

COLORADO.

Mesa County:	
Aug. 23–25—	
Grand Junction	2
Colo., State total	2

CONNECTICUT.

New Haven County:	
June 22–July 10—	
New Haven	9
Conn., State total	9

DELAWARE.

Kent County:	
Sept. 20–Oct. 10—	
Kenton	15
Del., State total	15

FLORIDA.

Alachua County:	
Apr.—	
Clyatt	3
Fla., State total	3

GEORGIA.

	Cars.
Barrow County:	
Mar. 1–30—	
Winder	2
Ga., State total	2

ILLINOIS.

Alexander County:	
May 20–29—	
Cache	5
Cook County:	
July 5–8—	
Chicago	1
Madison County:	
Oct. 7—	
Alton	1
Ill., State total	7

INDIANA.

Vermilion County:	
June 1—	
Cayuga	1
Vigo County:	
May 30–June 16—	
Perkins	10
Terre Haute	31
Ind., State total	42

IOWA.

Lee County:	
Sept. 10–Oct. 20—	
Montrose	2
Iowa, State total	2

KENTUCKY.

Jefferson County:	
June 20—	
Louisville	1
Ky., State total	1

LOUISIANA.

Claiborne Parish:	
Jan. 1–Apr. 30—	
Haynesville	25
Ouachita Parish:	
May 5—	
Monroe	2
La., State total	27

MARYLAND.

Baltimore City:	
May 23–June 14—	
Baltimore	7
Dorchester County:	
May 20—	
Cambridge	22
East New Market	6

MARYLAND—Continued.

	Cars.
Somerset County:	
May—	
Princess Anne	1
May—	
Pocomoke River landings	16
Md., State total	52

MISSISSIPPI.

Copiah County:	
Apr. 15–May 20—	
Crystal Springs	62
Hopewell	2
Forrest County:	
May 29–June 16—	
Hattiesburg	2
Miss., State total	66

NEW JERSEY.

Burlington County:	
June 6–26—	
Beverly	20
Delanco	12
Edgewater Park	28
Cape May County:	
June—	
Goshen	2
Cumberland County:	
June 9–29.	
South Vineland	7
Hudson County:	
May 29—	
Jersey City	1
N. J., State total	70

NEW YORK.

Chautauqua County:	
July 15–Aug. 1—	
Irving	5
Erie County:	
July 1–Sept. 10—	
Angola	6
Buffalo	2
Hamburg	30
Kings County:	
Aug. 12—	
Brooklyn	1
Madison County:	
July 10–Aug. 15—	
Hamilton	22
Hubbardsville	6
Morrisville	7
Poolville	16
Randallsville	31
Solsville	18
N. Y., State total	144

NORTH CAROLINA.

Wayne County:	
May 4–June 17—	
Goldsboro	9
N. C., State total	9

PULSE CROPS—Continued.

Table 71.—GREEN PEAS—Continued.

SOUTH CAROLINA.

	Cars.
Beaufort County:	
Apr. 10–May 30—	
Port Royal	7
Charleston County:	
Apr. 12–May 10—	
Charleston	20
S. C., State total	27

TENNESSEE.

Haywood County:	
May 13–17—	
Stanton	2
Tenn., State total	2

TEXAS.

Henderson County:	
June—	
Murchison	2
Tex., State total	2

VIRGINIA.

	Cars.
Accomac County:	
May 15–June 15—	
Belle Haven	1
Bloxom	1
Keller	3
Le Cato	1
Onley	1
Painter	3
Elizabeth City County:	
May 12–June 4—	
Old Point Comfort	13
Gloucester County:	
May 17–29—	
Allmondsville	1
Claybank	1
Clements Wharf	1
Gloucester Point	6
Norfolk County:	
May 2–Nov. 10—	
Norfolk	320
Port Norfolk	12
Portsmouth	1

VIRGINIA—Continued.

	Cars.
Northampton County:	
May 15–June 10—	
Birds Nest	2
Cheriton	3
Cobb	1
Exmore	2
Nassawadox	3
York County:	
May 15–June 1—	
Yorktown	5
May—	
Occohannock River landings	17
May–June—	
Piankatank River landings	3
May–June—	
Potomac River landings	1
May–June—	
Rappahannock River landings	28
Va., State total	430

DRY PULSE CROPS.

Table 72.—DRY BEANS.

ALABAMA.

	Cars.
Barbour County:	
Eufaula	15
Butler County:	
Chapman	7
Covington County:	
Gantt	33
Houston County:	
Ashford	1
Columbia	6
Montgomery County:	
Ramer	3
Pike County:	
Linwood	1
Ala., State total	66

CALIFORNIA.

Alameda County:	
Centerville	1
Contra Costa County:	
Oakley	2
Kern County:	
Shafter	1
Los Angeles County:	
El Rio	6
Los Angeles	3
Los Nietos	1
Pico	1
San Pedro	16
Santa Monica	2
Sawtelle	2
Wilmington	2
Orange County:	
Anaheim	13
Garden Grove	3
Irvine	487
San Juan Capistrano	93
Santa Ana	37
Smeltzer	2
Tustin	12
Sacramento County:	
Sacramento	14
San Diego County:	
Cardiff	9
Encinitas	5
San Francisco County:	
San Francisco	439
San Joaquin County:	
Stockton	103
Woodsboro	3

CALIFORNIA—Continued.

	Cars.
Santa Clara County:	
San Jose	5
Santa Cruz County:	
Watsonville	1
Stanislaus County:	
Modesto	50
Tulare County:	
Lindsay	1
Ventura County:	
Montalvo	2
Oxnard	3
Ventura	2
Cal., State total	1,321

COLORADO.

Adams County:	
Barr	1
Elbert County:	
Elbert	2
Logan County:	
Sterling	1
Weld County:	
Crest	1
Greeley	84
Grover	6
Keenesburg	2
Kersey	1
Roggen	4
Severance	1
Colo., State total	103

FLORIDA.

Alachua County:	
Kirkwood	1
Fla., State total	1

GEORGIA.

Emanuel County:	
Morristown	1
Ga., State total	1

IDAHO.

Latah County:	
Deary	4
Idaho, State total	4

ILLINOIS.

	Cars.
Cook County:	
Chicago	2
St. Clair County:	
Broadway	1
Ill., State total	3

LOUISIANA.

Orleans Parish:	
New Orleans	12
La., State total	12

MARYLAND.

Baltimore City:	
Baltimore	58
Md., State total	58

MICHIGAN.

Alcona County:	
Harrisville	4
Allegan County:	
Shelbyville	3
Antrim County:	
Bellaire	3
Central Lake	3
Ellsworth	6
Arenac County:	
Au Gres	6
Pine River	17
Turner	59
Twining	23
Barry County:	
Doster	1
Freeport	4
Hastings	3
Woodland	15
Bay County:	
Bay City	40
Benzie County:	
Beulah	3
Clare County:	
Farwell	8
Clinton County:	
St. Johns	43
Eaton County:	
Bellevue	4
Mulliken	6
Sunfield	20

DRY PULSE CROPS—Continued.

Table 72.—DRY BEANS—Continued.

MICHIGAN—Continued.

	Cars.
Emmet County:	
Petosky	1
Genesee County:	
Clio	1
Fenton	14
Flint	34
Gaines	6
Mount Morris	8
Gratiot County:	
Bannister	6
Breckenridge	75
Forest Hill	6
North Star	13
St. Louis	13
Wheeler	13
Huron County:	
Bad Axe	25
Bay Port	18
Elkton	96
Port Austin	16
Port Hope	21
Ingham County:	
Lansing	55
Mason	27
Ionia County:	
Muir	7
Portland	23
Saranac	31
Iosco County:	
Hale	3
McIvar	1
Whittemore	14
Isabella County:	
Mount Pleasant	75
Shepherd	35
Jackson County:	
Jackson	26
Kent County:	
Ada	29
Cedar Springs	10
Lowell	12
Sand Lake	15
Lake County:	
Luther	1
Lapeer County:	
Imlay City	1
North Branch	13
Leelanau County:	
Empire	2
Livingston County:	
Howell	1
Pinckney	8
Manistee County:	
Arcadia	4
Copemish	7
Norwalk	1
Onekama	9
Mason County:	
Fountain	11
Mecosta County:	
Barryton	5
Big Rapids	83
Rodney	1
Midland County:	
Coleman	7
Sanford	8
Missaukee County:	
McBain	20
Montcalm County:	
Amble	7
Butternut	10
Howard City	28
Lakeview	50
Pierson	2
Sidney	2
Stanton	2
Vickeryville	9
Muskegon County:	
Bailey	7
Slocum	5
Newaygo County:	
Fremont	11
Newaygo	4

MICHIGAN—Continued.

	Cars.
Oakland County:	
Clyde	1
Oxford	2
Oceana County:	
Hart	33
Pentwater	1
Ogemaw County:	
Rose City	2
Osceola County:	
Hersey	3
Marion	1
Sears	1
Ottawa County:	
Coopersville	4
Zeeland	6
Saginaw County:	
Birch Run	54
Merrill	21
Saginaw	6
St. Clair County:	
Port Huron	64
Sanilac County:	
Carsonville	61
McGregor	1
Minden City	5
Shiawassee County:	
Byron	4
Lennon	23
Owosso	41
Perry	11
Vernon	25
Tuscola County:	
Akron	6
Fairgrove	25
Fostoria	2
Gilford	12
Vassar	20
Wexford County:	
Mesick	4
Mich., State total	1,758

MINNESOTA.

Isanti County:	
Cambridge	5
Isanti	16
Millelacs County:	
Princeton	1
Todd County:	
Browerville	2
Minn., State total	24

NEW JERSEY.

Hudson County:	
Manhattan Piers	9
N. J., State total	9

NEW MEXICO.

Colfax County:	
Springer	4
Curry County:	
Melrose	2
Lincoln County:	
Corona	1
Mora County:	
Shoemaker	2
Rio Arriba County:	
Espanola	1
Santa Fe County:	
Santa Fe	2
Stanley	12
Torrance County:	
Estancio	64
Mountainair	84

NEW MEXICO—Continued.

	Cars.
Union County:	
Clayton	75
Dedman	3
Des Moines	1
N. Mex., State total	251

NEW YORK.

Allegany County:	
Belfast	1
Canaseraga	23
Rossburg	7
Clinton County:	
Beekmantown	1
Plattsburg	2
Erie County:	
Marilla	5
Franklin County:	
Fort Covington	1
Genesee County:	
Darien Center	17
Le Roy	69
Linden	3
Livingston County:	
Avon	13
Conesus	6
Geneseo	11
Lakeville	1
Tuscarora	56
Monroe County:	
Honeoye Falls	7
New York County:	
New York	13
Ontario County:	
Geneva	13
Seneca County:	
McDougall	4
Steuben County:	
Bath	7
Suffolk County:	
Jamesport	12
Wayne County:	
Sodus Center	2
Wyoming County:	
Pearl Creek	13
Perry	15
Portageville	7
Warsaw	8
Yates County:	
Branchport	2
Rock Stream	1
Rushville	27
N. Y., State total	347

NORTH CAROLINA.

Beauford County:	
Edward	1
Pamlico County:	
Vandemere	2
N. C., State total	3

PENNSYLVANIA.

Philadelphia County:	
Shackamaxon	1
Pa., State total	1

TENNESSEE.

Johnson County:	
Shouns	2
Tenn., State total	2

DRY PULSE CROPS—Continued.

Table 72.—DRY BEANS—Continued.

TEXAS.	Cars.
Hartley County:	
Romero	5
Tex., State total	5

VERMONT.	
Grand Isle County:	
Grand Isle	4
South Hero	8
Vt., State total	12

VIRGINIA.	Cars.
Campbell County:	
Lynchburg	7
Henrico County:	
Richmond	9
Roanoke County:	
Roanoke	1
Va., State total	17

WEST VIRGINIA.	
Wood County:	
Parkersburg	1
W. Va., State total	1

WISCONSIN.	Cars.
Columbia County:	
Fall River	1
Portage	9
Poynette	1
Marquette County:	
Westfield	7
Waushara County:	
Coloma	3
Wis., State total	21

Table 73.—DRY PEAS.

ALABAMA.	Cars.
Autauga County:	
Autaugaville	1
Dallas County:	
Burnsville	2
Dekalb County:	
Fort Payne	1
Lee County:	
Opelika	3
Pike County:	
Linwood	1
Ala., State total	8

ARIZONA.	
Santa Cruz County:	
Nogales	57
Ariz., State total	57

ARKANSAS.	
Columbia County:	
Emerson	2
Magnolia	9
Waldo	4
Union County:	
El Dorado	3
Ark., State total	18

CALIFORNIA.	
Orange County:	
Tustin	1
San Francisco County:	
San Francisco	15
Cal., State total	16

COLORADO.	
Conejos County:	
Antonito	44
Romeo	42
Costilla County:	
Blanca	4
Mesita	3
Denver County:	
Denver	2
Colo., State total	95

DELAWARE.	
Sussex County:	
Stockley	8
Del., State total	8

IDAHO.	
Fremont County:	
St. Anthony	3
Idaho, State total	3

LOUISIANA.	Cars.
Lincoln Parish:	
Ruston	4
Orleans Parish:	
New Orleans	12
La., State total	16

MICHIGAN.	
Alcona County:	
Harrisville	9
Alpena County:	
Lachine	3
Ossineke	8
Arenac County:	
Twining	1
Delta County:	
Vans Harbor	3
Emmet County:	
Harbor Springs	1
Huron County:	
Elkton	1
Port Austin	3
Iosco County:	
Hale	1
McIvar	2
Whittemore	3
Isabella County:	
Mount Pleasant	1
Leelanau County:	
Northport	5
Suttons Bay	2
Menominee County:	
Carney	4
Daggett	5
St. Clair County:	
Port Huron	19
Sanilac County:	
Minden City	2
Mich., State total	73

MINNESOTA.	
Ramsey County:	
St. Paul	2
Minn., State total	2

MONTANA.	
Gallatin County:	
Bozeman	48
Manhattan	2
Silverbow County:	
Butte	1
Mont., State total	51

NEW JERSEY.	
Hudson County:	
Manhattan Piers	2
N. J., State total	2

NEW YORK.	Cars.
Chautauqua County:	
Jamestown	1
Genesee County:	
Le Roy	1
New York County:	
New York	5
Richmond County:	
St. George Lighterage	5
N. Y., State total	12

NORTH CAROLINA.	
Perquimans County:	
Nicanor	4
N. C., State total	4

OHIO.	
Ashtabula County:	
Ashtabula Harbor	1
Ohio, State total	1

OREGON.	
Jackson County:	
Medford	6
Oreg., State total	6

PENNSYLVANIA.	
Philadelphia County:	
Philadelphia	10
Pa., State total	10

VIRGINIA.	
Henrico County:	
Richmond	14
Nansemond County:	
Suffolk	7
Va., State total	21

WASHINGTON.	
King County:	
Seattle	5
Wash., State total	5

WISCONSIN.	
Barron County:	
Cumberland	42
Calumet County:	
Hayton	18
New Holstein	81
Chippewa County:	
Eagle Point	2

DRY PULSE CROPS—Continued.

Table 73.—DRY PEAS—Continued.

WISCONSIN—Continued.

	Cars.
Dodge County:	
Fox Lake	1
Reeseville	15
Fond du Lac County:	
Brandon	4
Jefferson County:	
Watertown	5
Kewaunee County:	
Algoma	10

WISCONSIN—Continued.

	Cars.
Manitowoc County:	
Kiel	9
Maribel	38
Marinette County:	
Beaver	11
Coleman	9
Wausaukee	1
Oconto County:	
Lena	6

WISCONSIN—Continued.

	Cars.
Pepin County:	
Stockholm	1
Sheboygan County:	
Sheboygan Falls	17
Vernon County:	
Newton	2
Wis., State total	272

MISCELLANEOUS CROPS.

Table 74.—GREEN CORN.

CALIFORNIA.

	Cars.
Imperial County:	
May 8—	
El Centro	1
Stanislaus County:	
Oct. 13—	
Turlock	1
Cal., State total	2

FLORIDA.

Seminole County:	
May 1–June 30—	
Sanford	6
Fla., State total	6

ILLINOIS.

Champaign County:	
Aug. 25–Sept. 5—	
Foosland	26
McLean County:	
Aug. 30–Sept. 2—	
Osman	4
Madison County:	
July 8–16—	
Poag	12
Shelby County:	
Aug.—	
Fancher	1
Ill., State total	43

INDIANA.

Johnson County:	
Aug.–Sept.	
Bargersville	7
Edinburg	7
Randolph County:	
Aug. 23–Sept. 8—	
Saratoga	14
Vigo County:	
Aug. 18–27—	
Terre Haute	4
Ind., State total	32

IOWA.

Delaware County:	
Aug.—	
Manchester	7
Iowa, State total	7

KENTUCKY.

Jefferson County:	
July 31—	
Louisville	1
Ky., State total	1

LOUISIANA.

	Cars.
Lafourche Parish:	
Apr. 10–Dec. 20—	
Raceland	150
Orleans Parish:	
May 23–July 13—	
New Orleans	95
La., State total	245

MAINE.

Oxford County:	
Sept. 13–28—	
East Hebron	1
East Sumner	1
Me., State total	2

MARYLAND.

Caroline County:	
July 17–Aug. 2—	
Federalsburg	3
Harford County:	
July–Oct.—	
Rocks	3
Md., State total	6

MICHIGAN.

Montcalm County:	
Aug.–Sept.—	
Lakeview	20
Stanton	3
Newaygo County:	
Aug.–Sept.—	
Newaygo	5
Mich., State total	28

MISSOURI.

Franklin County:	
Aug. 17—	
Gray's Summit	1
Greene County:	
Aug.—	
Haseltine	1
Mo., State total	2

NEBRASKA.

Dodge County:	
Aug.—	
Fremont	3
Nebr., State total	3

NEW JERSEY.

	Cars.
Burlington County:	
July 10–Aug. 4—	
Beverly	1
Delanco	54
Edgewater Park	108
Monmouth County:	
Aug. 21–Sept. 5—	
Freehold	2
N. J., State total	165

NEW YORK.

Cattaraugus County:	
Aug. 20—	
Perrysburg	1
Livingston County:	
Oct. 2–12—	
Avon	10
Lakeville	3
South Lima	1
N. Y., State total	15

NORTH CAROLINA.

Beaufort County:	
June—	
Edward	2
Duplin County:	
June 3–July 18—	
Faison	7
Rose Hill	58
Wallace	19
Pamlico County:	
June 27–July 4—	
Vandemere	2
Sampson County:	
June 20–July 20—	
Clinton	72
Turkey	42
Wayne County:	
June 24–July 14—	
Mt. Olive	2
N. C., State total	204

OHIO.

Clark County:	
Sept. 2–3—	
Bowlusville	2
Fayette County:	
Sept. 27–28—	
Washington C. H.	2
Lucas County:	
Aug. 17–Oct. 2—	
Toledo	37
Ross County:	
Aug. 23–Sept. 1—	
Higby	1
Richmondale	3
Washington County:	
Aug. 9—	
Lowell	1
Ohio, State total	46

MISCELLANEOUS CROPS—Continued.

Table 74.—GREEN CORN—Continued.

	Cars.
PENNSYLVANIA.	
Philadelphia County:	
July—	
Philadelphia	3
Pa., State total	3
SOUTH CAROLINA.	
Charleston County:	
June 17—	
Charleston	1
S. C., State total	1
TEXAS.	
Hidalgo County:	
May 17–24—	
Mission	2
Tex., State total	2
UTAH.	
Weber County:	
Oct. 6—	
Ogden	1
Utah, State total	1
VERMONT.	
Chittenden County:	
Sept. 8–18—	
Jonesville	8
Windham County:	
Sept. 21–Oct. 4—	
East Putney	1
Westminster	3
Vt., State total	12
VIRGINIA.	
Norfolk County:	
July 5–23—	
Norfolk	2
Northampton County:	
July 29–Aug. 2—	
Cheriton	2
Va., State total	4
WEST VIRGINIA.	
Wood County:	
Aug. 19—	
Parkersburg	1
W. Va., State total	1
WISCONSIN.	
Shawano County:	
Sept. 9–15—	
Gresham	3
Trempealeau County:	
Aug. 24–Sept. 1—	
Trempealeau	7
Wis., State total	10

Table 75.—SPINACH.

	Cars.
CONNECTICUT.	
New Haven County:	
May 23–June 22—	
New Haven	2
Conn., State total	2
ILLINOIS.	
Cook County:	
Nov. 19–Dec. 4—	
Chicago	1
Union County:	
Nov. 13–Dec. 2—	
Balcom	8
Ill., State total	9
MARYLAND.	
Baltimore City:	
Jan. 26–Dec. 29—	
Baltimore	39
Md., State total	39
MASSACHUSETTS.	
Hampshire County:	
May 3–10—	
North Hatfield	3
Mass., State total	3
MISSOURI.	
St. Louis City:	
May 16—	
St. Louis	1
Mo., State total	1
NEW JERSEY.	
Monmouth County:	
May 18—	
Marlboro	1
N. J., State total	1
NEW YORK.	
Chautauqua County:	
Nov. 1—	
Jamestown	1
Kings County:	
Nov.–Apr.—	
Brooklyn	11
Livingston County:	
June 7–15—	
South Lima	22
Seneca County:	
July 12—	
McDougall	1
N. Y., State total	35
PENNSYLVANIA.	
Philadelphia County:	
Nov.–Dec. 2—	
Philadelphia	4
Pa., State total	4
RHODE ISLAND.	
Providence County:	
May 10–18—	
Auburn	11
R. I., State total	11
TEXAS.	
Cameron County:	
Feb.—	
Brownsville	2
San Benito	1
Dimmit County:	
Mar. 15—	
Carrizo Springs	8
Fort Bend County:	
Mar. 7–11—	
Sugar Land	13
Travis County:	
Jan. 3–Apr. 20—	
Austin	84
Webb County:	
Jan. 4–Feb. 24—	
Laredo	72
Tex., State total	180
VIRGINIA.	
Norfolk County:	
Oct. 25–May 11—	
Fentress	3
Norfolk	2,325
Port Norfolk	28
Portsmouth	2
Princess Anne County:	
Nov.–Apr.—	
London Bridge	10
Va., State total	2,368

Table 76.—MIXED VEGETABLES.

	Cars.
ALABAMA.	
Elmore County:	
July 11—	
Coosada	1
Mobile County—	
Jan. 1–Dec. 31—	
Mobile	2
Theodore	25
ALABAMA—Continued.	
Pike County:	
Mar. 30—	
Linwood	1
Ala., State	29
ARKANSAS.	
Sebastian County:	
June 10–July 10—	
Fort Smith	2
Ark., State total	2

MISCELLANEOUS CROPS—Continued.

Table 76.—MIXED VEGETABLES—Continued.

CALIFORNIA.

	Cars.
Alameda County:	
Mar. 10–June 20—	
Alameda	1
Lorenzo	4
Niles	1
Butte County:	
July—	
Speedway	2
Los Angeles County—	
Jan. 3–Dec. 31—	
Artesia	1
Bandini	16
Central Avenue	22
Compton	1
El Monte	20
Florence	51
Hobart	4
Hynes	2
Inglewood	2
Kester	1
Long Beach	2
Los Angeles	1,120
Newmark	52
Palms	5
Pico	2
Pomona	1
Puente	2
Redondo Beach	9
Rivera	35
Rosemead	2
Rowland	1
San Gabriel	8
San Pedro	6
Tropico	1
Vernondale	95
Watts	13
Wilmington	4
Orange County:	
Feb. 22–Oct. 18—	
Buena Park	1
Fullerton	2
Garden Grove	2
West Anaheim	2
Plumas County:	
July 23—	
Quincy Junction	1
Riverside County:	
Feb. 3–Aug. 7—	
Banning	10
Riverside	1
Sacramento County:	
Jan. 15–Dec. 30—	
Hood	1
Sacramento	460
Walnut Grove	2
San Bernardino County:	
Aug. 15–Dec. 18—	
Alta Loma	1
Upland	1
San Francisco County:	
Jan. 6–Dec. 30—	
San Francisco	297
San Joaquin County:	
Jan. 6–Dec. 27—	
Manteca	1
Stockton	8
San Mateo County:	
Nov. 4–Dec. 29—	
Colma	61
Santa Clara County:	
Dec. 7–8—	
San Jose	2
Stanislaus County:	
Aug. 22—	
Turlock	2
Yuba County:	
Sept. 10–27—	
Marysville	4
Mission	1
Rio Oso	1
Cal., State total	2,347

COLORADO.

	Cars.
Adams County:	
July 24–Oct. 7—	
Brighton	24
Hazeltine	4
Arapahoe County:	
Sept. 7–Nov. 22—	
Englewood	1
Littleton	8
Denver County:	
Feb. 8–Dec. 16—	
Denver	71
Fremont County:	
Oct. 11–22—	
Florence	2
Garfield County:	
Sept. 6—	
Silt	1
Larimer County:	
Sept. 18–Oct. 14—	
Fort Collins	8
Montezuma County:	
Nov. 14—	
Dolores	1
Montrose County:	
Sept. 16–Dec. 26—	
Olathe	74
Pueblo County:	
Sept. 28–Dec. 2—	
Pueblo	2
Weld County:	
Jan. 5–Dec. 22—	
Ault	25
Cloverly	9
Eaton	16
Galeton	1
Gill	2
Greeley	99
Ione	4
Kersey	8
La Salle	1
Lucerne	46
Lupton	3
Pierce	1
Wattenberg	11
Colo., State total	422

CONNECTICUT.

Litchfield County:	
Nov. 3—	
Bantam	2
New Milford	1
New Haven County:	
July 5–7—	
New Haven	3
Conn., State total	6

FLORIDA.

Hillsborough County:	
Apr. 28–June 20—	
Plant City	17
Lee County:	
May 27–Dec. 24—	
Fort Meyers	11
Manatee County:	
Apr.–June—	
Ellenton	71
Orange County:	
Apr.–June—	
Tildenville	17
Fla., State total	116

GEORGIA.

Chatham County:	
Apr.–Nov.—	
Savannah	70
Ga., State total	70

IDAHO.

	Cars.
Ada County:	
July 27—	
Boise	1
Latah County:	
Nov. 19—	
Moscow	1
Idaho, State total	2

ILLINOIS.

Cook County:	
Jan.–Dec. 31—	
Chicago	89
Dunning	13
Orchard Place	12
St. Clair County:	
May 16–Oct. 12—	
East St. Louis	7
Union County:	
Apr. 22–Dec. 30—	
Anna	60
Balcom	29
Cobden	10
Ill., State total	211

INDIANA.

Fulton County:	
Sept. 30—	
Akron	1
St. Joseph County:	
May 17—	
Walkerton	1
Ind., State total	2

IOWA.

Woodbury County:	
Feb. 19–Oct. 6—	
Sergeant Bluff	3
Iowa, State total	3

KANSAS.

Leavenworth County:	
Oct. 18—	
Lenape	1
Shawnee County:	
Feb. 24–Dec. 9—	
North Topeka	2
Topeka	7
Kans., State total	10

KENTUCKY.

Jefferson County:	
May 31–Aug. 8—	
Louisville	43
Ky., State total	43

LOUISIANA.

Calcasieu Parish:	
June 19—	
Lake Charles	1
Iberia Parish:	
Mar. 18–June 19—	
New Iberia	2
Jefferson Parish:	
Apr. 27–May 24—	
Kenner	10
Orleans Parish:	
Apr. 26–Dec. 31—	
New Orleans	136
Rapides Parish:	
Apr.–June—	
Alexandria	3

MISCELLANEOUS CROPS—Continued.

Table 76.—MIXED VEGETABLES—Continued.

LOUISIANA—Continued.

	Cars.
St. Charles Parish:	
Jan. 1–June 23—	
Destrehan	33
Hahnville	8
Luling	168
St. John the Baptist Parish:	
Jan. 23–June 22—	
Montegut	23
Tangipahoa Parish:	
Apr. 10–May 6—	
Tickfaw	10
La., State total	394

MAINE.

Oxford County:	
Nov. 28—	
Norway	1
York County:	
Nov. 10—	
Buxton	1
Me., State total	2

MARYLAND.

Baltimore City:	
Mar. 12–Nov. 21—	
Baltimore	49
Md., State total	49

MASSACHUSETTS.

Essex County:	
Jan. 25—	
Lawrence	1
Franklin County:	
Aug.—	
Northfield	3
Mass., State total	4

MICHIGAN.

Alpena County:	
Nov. 19—	
Lachine	1
Baraga County:	
Oct. 20–Nov. 9—	
Keweenaw Bay	4
Bay County:	
Sept.—	
Bay City	3
Delta County:	
Oct. 12—	
Escanaba	1
Emmet County:	
Dec. 4—	
Pellston	2
Houghton County:	
Oct. 26—	
Alston	1
Nisula	1
Ingham County:	
Sept.–Dec.—	
Mason	107
Marquette County:	
Nov. 1—	
Ishpeming	1
Mich., State total	121

MINNESOTA.

Hennepin County:	
July 22–Aug. 19—	
Camden Place	17
Minneapolis	17
Itasca County:	
Nov. 9—	
Grand Rapids	1

MINNESOTA—Continued.

	Cars.
Pennington County:	
June—	
Thief River Falls	1
Pine County:	
June—	
Sandstone	1
Ramsey County:	
July 6–Dec. 31—	
St. Paul	45
St. Louis County:	
Nov. 3—	
Virginia	1
Washington County:	
Jan. 1–Dec. 31—	
Stillwater	5
Minn., State total	88

MISSISSIPPI.

Copiah County:	
May 3–June 20—	
Gallman	47
Gatesville	2
Hazlehurst	26
Hopewell	10
Harrison County:	
Jan. 1–Nov. 16—	
Long Beach	192
Pike County:	
May 26—	
Osyka	1
Miss., State total	278

MISSOURI.

Jackson County:	
Oct. 13—	
Kansas City	1
St. Louis City:	
Jan. 21–Dec. 28—	
St. Louis	6
Mo., State total	7

MONTANA.

Lewis and Clark County:	
Aug. 26—	
Helena	1
Ravalli County:	
Jan. 1–Nov. 6—	
Hamilton	2
Woodside	7
Silverbow County:	
Nov. 10–24—	
Butte	2
Yellowstone County:	
Apr. 8–Sept. 20—	
Billings	9
Mont., State total	21

NEBRASKA.

Buffalo County:	
Nov. 1—	
Kearney	1
Douglas County:	
July 14—	
Omaha	1
Hall County:	
Nov.—	
Grand Island	1
Lancaster County:	
June 9–Aug. 15—	
Lincoln	2
Neb., State total	5

NEVADA.

	Cars.
Clark County:	
Mar. 9—	
Overton	1
Washoe County:	
Feb. 3–Nov. 9—	
Reno	5
Nev., State total	6

NEW HAMPSHIRE.

Coos County:	
Oct. 10—	
Percy	1
N. H., State total	1

NEW JERSEY.

Atlantic County:	
July 5–Sept. 30—	
Landisville	3
Wheat Road	25
Burlington County:	
July—	
Edgewater Park	1
Cumberland County:	
July 12–Aug. 25—	
Cedarville	1
Fairton	6
Greenwich	4
Port Norris	1
Gloucester County:	
July–Sept.—	
Malaga	21
Richwood	3
Monmouth County:	
July 12–17—	
Morganville	332
Port Monmouth	3
N. J., State total	400

NEW MEXICO.

Eddy County:	
Sept.—	
Lakewood	4
Otero County:	
Sept. 25–Dec. 12—	
Cloudcroft	7
N. Mex., State total	11

NEW YORK.

Albany County:	
Aug.—	
Albany	1
Cayuga County:	
May 23–Dec.—	
Crockett	1
Moravia	1
Sennett	1
Cortland County:	
Nov. 25—	
Homer	1
Delaware County:	
Dec. 9—	
Hamden	1
Sidney	1
Erie County:	
Aug. 12–Dec.—	
Akron Falls	1
Buffalo	2
Crittenden	1
Genesee County:	
Oct.–Dec.—	
Alabama	1
Corfu	1
Elba	2
North Bergen	1
Kings County:	
Apr. 1–Oct. 15—	
Brooklyn	14

MISCELLANEOUS CROPS—Continued.

Table 76.—MIXED VEGETABLES—Continued.

NEW YORK—Continued.

	Cars.
Madison County:	
Oct.–Dec.—	
Canastota	3
Lebanon	1
Solsville	1
Monroe County:	
Sept.–Dec.—	
Brockport	1
Fairport	2
Hilton	8
Pittsford	1
Rochester	1
Spencerport	1
Walker	3
Webster	2
Nassau County:	
Sept.–Dec.—	
Farmingdale	7
New York County:	
Feb. 5–Dec. 20—	
New York	37
Niagara County:	
Oct.–Nov.—	
Middleport	5
Onondaga County:	
Oct.–Dec.—	
Halfway	3
Martisco	1
Skaneateles	1
Ontario County:	
Oct.–Dec.—	
Clifton Springs	1
Phelps	4
Orange County:	
June 23–Oct. 7—	
Middletown	10
New Hampton	4
Oswego County:	
Oct.–Dec.—	
Central Square	1
Fulton	3
Furniss	4
Oswego	1
Phoenix	1
Otsego County:	
Oct. 16—	
Fly Creek	1
Seneca County:	
Oct.–Nov.—	
Junius	1
Waterloo	2
Suffolk County:	
Nov. 8–15—	
Wyandanch	3
Ulster County:	
Dec. 23—	
Accord	1
Washington County:	
Oct.—	
Salem	1
Wayne County:	
Sept.–Dec.—	
Alton	1
Clyde	2
East Williamson	6
Fruitland	2
Lyons	6
North Macedon	2
North Rose	1
Ontario	37
Port Gibson	3
Savannah	1
Sodus	18
Walworth	2
Williamson	12
Wolcott	1
Wyoming County:	
Oct.—	
North Java	7
N. Y., State total	242

NORTH CAROLINA.

	Cars.
Currituck County:	
June 10–July 5	
Moyock	12
New Hanover County:	
May–July—	
Castle Hayne	22
Pender County:	
May 29—	
Rocky Point	2
Surry County:	
Aug. 31–Sept. 7—	
Mt. Airy	2
Wayne County:	
June 13–July 25—	
Goldsboro	3
Mt. Olive	5
Yancey County:	
Sept. 30–Dec. 1—	
Burnsville	8
N. C., State total	54

OHIO.

Cuyahoga County:	
June 14–Dec. 23—	
Cleveland	3
Franklin County:	
Sept.—	
Columbus	1
Hamilton County:	
July 29–Oct. 13—	
Cincinnati	8
Lucas County:	
Aug. 22—	
Olive Street Junction	1
Toledo	16
Medina County:	
Sept. 1–22—	
Lodi	3
Washington County:	
July 20–Aug. 15—	
Lowell	18
Waterford	9
Ohio, State total	59

OKLAHOMA.

Pottawatomie County:	
May 31—	
Shawnee	1
Okla., State total	1

OREGON.

Douglas County:	
Dec. 15—	
Roseburg	1
Lane County:	
Feb. 17—	
Eugene	1
Multnomah County:	
Jan. 22–Dec. 30—	
East Portland	95
Portland	4
Troutdale	2
Umatilla County:	
July 18–Dec. 2—	
Freewater	14
Oreg., State total	117

PENNSYLVANIA.

Crawford County:	
Nov.—	
Titusville	1
Erie County:	
Nov. 6—	
Union City	1

PENNSYLVANIA—Contd.

	Cars.
Lackawanna County:	
Dec. 1	
Carbondale	1
Philadelphia County:	
Nov.—	
Philadelphia	25
Potter County:	
Oct.–Nov.	
Mill[illegible]	2
Schuylkill County:	
Nov. 4—	
Tamaqua	1
Tioga County:	
Sept.–Oct.—	
Wellsboro Junction	2[illegible]
York County:	
Aug. 17—	
Brogueville	1
Pa., State total	55

SOUTH CAROLINA.

Beaufort County:	
Jan. 20–July 3—	
Beaufort	4
Charleston County:	
Apr. 1–June 29—	
Charleston	29
Williamsburg County:	
May 31–June 9—	
Cades	[illegible]
S. C., State total	339

SOUTH DAKOTA.

Lawrence County:	
Oct. 12–Nov.—	
Lead	1
Spearfish	2
Pennington County:	
Sept. 7—	
Rapid City	1
S. Dak., State total	4

TENNESSEE.

Maury County:	
June 24—	
Columbia	1
Tenn., State total	1

TEXAS.

Cameron County:	
Mar. 27–Apr. 19—	
Brownsville	10
Harlingen	5
San Benito	131
Santa Maria	4
Dallas County:	
Jan.–Dec. 24—	
Dallas	24
Harris County:	
May 31–June 24—	
Houston	21
Hidalgo County:	
May–June—	
Edinburg	1
McAllen	4
Mercedes	81
Mission	12
Webb County:	
May–June—	
Laredo	4
Tex., State total	317

MISCELLANEOUS CROPS—Continued.

Table 76.—MIXED VEGETABLES—Continued.

UTAH.	Cars.
Boxelder County:	
Sept. 29–Oct. 14—	
Brigham	1
Willard	5
Morgan County:	
Oct. 14–23—	
Morgan	18
Salt Lake County:	
Sept. 6–Dec. 6—	
Salt Lake City	5
Uinta County:	
Oct. 31–Nov. 10—	
American	2
Weber County:	
Aug. 10–Dec. 13—	
Ogden	26
Utah, State total	57

VERMONT.	
Orleans County:	
Oct. 25—	
Newport	1
Windham County:	
Nov. 7—	
South Vernon	1
Vt., State total	2

VIRGINIA.	
Campbell County:	
May 19—	
Lynchburg	1
Hanover County:	
July 5–15—	
East Atlee	2
Old Church	1
Norfolk County:	
May 10–Nov. 19—	
Norfolk	7
Port Norfolk	2
Page County:	
Aug.—	
Shenandoah	2
Stanley	1

VIRGINIA—Continued.	Cars.
Patrick County:	
June—	
Stuart	2
Princess Anne County:	
June 28—	
London Bridge	1
Wythe County:	
Aug. 18–Sept. 15—	
Crockett	4
Va., State total	23

WASHINGTON.	
Benton County:	
July—	
Kennewick	1
Prosser	1
Clarke County:	
May 22—	
Camas	1
King County:	
July 3–Dec. 18—	
Seattle	3
Spokane County:	
Jan. 1–Oct. 28—	
Spokane	14
Walla Walla County:	
Jan. 1–Nov. 30—	
Finch	1
Walla Walla	180
Yakima County:	
Jan. 1–Dec. 8—	
Grandview	1
North Yakima	17
Outlook	2
Sunnyside	2
Toppenish	3
Wapato	6
Wash., State total	232

WEST VIRGINIA.	Cars.
Wood County:	
July 8–Nov. 4—	
Parkersburg	2
Williamstown	10
W. Va., State total	12

WISCONSIN.	
Ashland County:	
Nov. 4—	
Ashland	1
Brown County:	
Oct. 5–Nov. 4—	
Green Bay	3
Eau Claire County:	
Aug. 3–Oct. 22—	
Eau Claire	5
Pierce County:	
Dec. 4—	
River Falls	1
Polk County:	
Aug.—	
Lewis	3
Racine County:	
Jan. 1–Dec. 30—	
Corliss	26
Rusk County:	
Oct. 9–24—	
Bruce	1
Hawkins	1
St. Croix County:	
Aug. 1–10—	
Northline	2
Shawano County:	
Oct. 22—	
Green Valley	1
Wis., State total	44

WYOMING.	
Sweetwater County:	
Nov. 10—	
Rock Springs	1
Wyo., State total	1

Table 77.—MIXED FRUIT AND VEGETABLES.

ALABAMA.	Cars.
Chilton County:	
Apr. 22–July 31—	
Thorsby	4
Ala., State total	4

ARKANSAS.	
Jefferson County:	
Nov. 15–Dec. 8—	
Pine Bluff	2
Ark., State total	2

CALIFORNIA.	
Alameda County:	
Mar. 16—	
Lorenzo	1
Imperial County:	
June 5–19—	
Brawley	1
El Centro	1
Los Angeles County:	
Jan. 22–Dec. 15—	
Los Angeles	133
San Fernando	1
Vernondale	1

CALIFORNIA—Continued.	Cars.
Riverside County:	
June 12–July 1—	
Coachella	7
Mecca	1
Sacramento County:	
Jan. 7–July 22—	
Sacramento	8
San Bernardino County:	
May 15—	
Rialto	1
San Francisco County:	
Apr. 10–Oct. 23—	
San Francisco	6
Stanislaus County:	
Aug. 24–28—	
Keyes	2
Cal., State total	163

COLORADO.	
Boulder County:	
Nov. 23—	
Lyons	1
Mesa County:	
Aug. 23—	
Clifton	1
Colo., State total	2

GEORGIA.	Cars.
Lowndes County:	
Aug. 19—	
Valdosta	1
Ga., State total	1

ILLINOIS.	
Cook County:	
Jan. 1–Dec. 31—	
Chicago	800
Jackson County:	
July–Aug.—	
Makanda	24
Pulaski County:	
July 15—	
Villa Ridge	1
St. Clair County:	
May 29–June 21—	
East St. Louis	3
Union County:	
July 6–Aug. 26—	
Anna	53
Ill., State total	881

INDIANA.	
Marion County:	
July 18–Sept. 21—	
Indianapolis	4

MISCELLANEOUS CROPS—Continued.

Table 77.—MIXED FRUIT AND VEGETABLES—Continued.

INDIANA—Continued.

	Cars.
Owen County:	
Aug. 3—	
Gosport	1
St. Joseph County:	
Aug.—	
Walkerton	1
Ind., State total	6

IOWA.

Linn County:	
Mar. 1–Dec. 25—	
Cedar Rapids	15
Muscatine County:	
Sept. 1–17—	
Fruitland	2
Polk County:	
Jan. 8–May 29—	
Des Moines	16
Iowa, State total	33

KENTUCKY.

Fayette County:	
Jan. 1–Dec. 31—	
Lexington	208
Jefferson County:	
Apr. 24–Dec. 27—	
Louisville	17
Ky., State total	225

LOUISIANA.

Orleans Parish:	
Mar. 19–Dec. 21—	
New Orleans	145
La., State total	145

MAINE.

Franklin County:	
Nov. 10—	
West Farmington	1
Me., State total	1

MARYLAND.

Baltimore City:	
Mar. 6–Dec. 30—	
Baltimore	362
Caroline County:	
July 24—	
Federalsburg	1
Garrett County:	
Nov. 24—	
Deer Park Village	1
Md., State total	364

MASSACHUSETTS.

Suffolk County:	
Aug. 31–Dec. 27—	
Boston	19
Mass., State total	19

MICHIGAN.

Allegan County:	
Sept. 14–Nov. 18—	
Douglas	124
Glenn	186
Pier Cove	186
Saugatuck	124

MICHIGAN—Continued.

	Cars.
Berrien County:	
July 11–Nov. 18—	
Benton Harbor	1,600
St. Joseph	811
Clinton County:	
Dec. 7—	
Shepardsville	1
Emmet County:	
Sept. 22–Nov. 11—	
Harbor Springs	1
Petosky	5
Manistee County:	
Dec. 14—	
Kaleva	1
Muskegon County:	
Sept. 21—	
Muskegon	3
Ottawa County:	
July 11–Nov. 18—	
Grand Haven	3
Holland	306
Van Buren County:	
Sept. 14–Oct. 30—	
South Haven	186
Mich., State total	3,537

MINNESOTA.

Hennepin County:	
Sept.–Oct.—	
Minneapolis	73
Ramsey County:	
Sept. 9—	
St. Paul	1
St. Louis County:	
May 10–Oct. 14—	
Duluth	34
Minn., State total	108

MISSOURI.

Carroll County:	
Oct. 5—	
Wakenda	1
Jasper County:	
June–Oct.—	
Joplin	54
St. Louis City:	
June 3–Oct. 25—	
St. Louis	5
Mo., State total	60

MONTANA.

Silverbow County:	
Aug. 24—	
Butte	1
Mont., State total	1

NEVADA.

Washoe County:	
Apr.–Oct.—	
Reno	15
Nev., State total	15

NEW JERSEY.

Burlington County:	
June 19–Sept. 26—	
Beverly	16
Edgewater Park	32
Cumberland County:	
Apr.–Nov. 30—	
Bridgeton	4
Greenwich	4
Vineland	4
Woodruff's	500

NEW JERSEY—Continued.

	Cars.
Gloucester County:	
Aug. 15—	
Richwood	1
Monmouth County:	
Jan. 1–Dec. 31—	
Hazlet	1,132
N. J., State total	1,693

NEW YORK.

Allegany County:	
July–Aug.—	
Canaseraga	1
Erie County:	
July 31–Aug. 2—	
Buffalo	15
New York County:	
June 19–Aug. 17—	
New York	10
Onondaga County:	
July 20–Dec.—	
Halfway	3
Syracuse	5
Ontario County:	
May 18–Dec. 8—	
Aloquin	1
Clifton Springs	1
Gorham	5
Seneca Castle	23
Seneca County:	
July 12–Dec. 16—	
McDougall	13
Tompkins County:	
Nov. 1—	
Dryden	6
Wayne County:	
Aug. 16–31—	
Lyons	1
Yates County:	
Sept. 16–Oct. 26—	
Bellona	1
Penn Yan	3
N. Y., State total	88

NORTH CAROLINA.

Sampson County:	
June 21–July 20—	
Turkey	8
Surry County:	
Aug. 16–Sept. 27—	
Mt. Airy	13
Wayne County:	
June 8–July 7—	
Mt. Olive	11
N. C., State total	32

OHIO.

Cuyahoga County:	
May 4–Dec. 28—	
Cleveland	98
Erie County:	
Aug.—	
Sandusky	5
Hamilton County:	
Jan. 1–Dec. 31—	
Cincinnati	592
Ottawa County:	
Sept. 2—	
Oak Harbor	1
Washington County:	
July 12–Aug. 21—	
Lowell	12
Marietta	3
Ohio, State total	711

MISCELLANEOUS CROPS—Continued.

Table 77.—MIXED FRUIT AND VEGETABLES—Continued.

	Cars.
OKLAHOMA.	
Pottawatomie County:	
June 20—	
Shawnee	1
Okla., State total	1
OREGON.	
Multnomah County:	
Dec. 12—	
East Portland	1
Oreg., State total	1
PENNSYLVANIA.	
Allegheny County:	
May 26—	
Pittsburgh	1
Berks County:	
July 3—	
Reading	1
Lackawanna County:	
Dec. 6–29—	
Carbondale	5
Philadelphia County:	
Jan. 3–Dec. 30—	
Philadelphia	421
Susquehanna County:	
Nov. 4—	
Kingsley	1
Tioga County:	
Dec. 10–31—	
Tioga Junction	2
Pa., State total	431
TEXAS.	
Cherokee County:	
July—	
Jacksonville	1
TEXAS—Continued.	
Eastland County:	
Aug. 4–9—	
Rising Star	2
Harris County:	
June 7–10—	
Houston	2
Hopkins County:	
June 20–July 17—	
Pickton	9
Tex., State total	14
UTAH.	
Salt Lake County:	
Sept. 27–Oct. 11—	
Salt Lake City	2
Utah, State total	2
VIRGINIA.	
Campbell County:	
Nov. 2—	
Lynchburg	2
Norfolk County:	
May 9–15—	
Port Norfolk	3
Page County:	
Aug.–Nov.—	
Shenandoah	2
Roanoke County:	
Nov. 8—	
Roanoke	4
Washington County:	
Aug.–Nov.—	
Abington	8
Wythe County:	
Aug. 12–Sept. 30—	
Crockett	53
Rural Retreat	1
Va., State total	73
WASHINGTON.	
Benton County:	
July 12—	
White Bluffs	
Spokane County:	
Jan. 1–Dec. 16—	
Spokane	9
Yakima County:	
Aug. 17—	
North Yakima	1
Wash., State total	11
WEST VIRGINIA.	
Hampshire County:	
Aug. 3–10—	
Romney	2
Mason County:	
Aug. 5—	
Letart	1
Wetzel County:	
Oct. 18—	
New Martinsville	1
W. Va., State total	4
WISCONSIN.	
Milwaukee County:	
Jan. 3–Dec. 27—	
Milwaukee	136
Racine County:	
Sept. 21—	
Racine	35
Wis., State total	171

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 668

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. ▼ May 21, 1918

NURSE PLANTING SELECT COTTON SEED.

By P. V. Cardon, *Assistant Agronomist, Office of Acclimatization and Adaptation of Crop Plants—Cotton Breeding.*

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THE WASTE OF SELECT COTTON SEED.

How to avoid waste of select cotton seed is a problem confronting every cotton breeder. In order to improve varieties and to maintain select stocks on the highest plane of superiority it is necessary to increase rapidly the best progenies. A relatively slow increase is all that is possible if the usual methods of planting are employed. The waste of valuable seed may prove to be a distinct loss not only to the breeder but to the cotton industry as well. If the waste of seed could be avoided, superior selections of cotton could be established in cultivation one, two, or more years earlier than is now considered possible.

The usual methods of increasing select cotton seed are wasteful in several ways. Though differing somewhat in detail, the main steps are essentially the same in all methods that have come to the writer's attention. The seeds of a select plant are planted first in hills in what is called a progeny row. Only one plant in each hill usually is desired, but it is customary to plant five to eight or more seeds. This is held to be necessary in order to insure a stand. Perfect germination is hardly to be expected, and many of the young seedlings do not survive. A single seedling may be unable to break through if the surface becomes crusted, but several seedlings by combined effort can push out. Under favorable conditions it would not be necessary to plant so many seeds in a hill, but such conditions can not be foretold and hence enough seed must be planted to secure a stand in an unfavorable season.

The natural result of a heavy rate of planting is a thick stand, in the reduction of which it frequently becomes necessary to destroy

50 to 75 per cent of the plants. To thin out large numbers of surplus plants, each of which probably would be capable of producing practically as many bolls as any of the plants left in the row, is extremely wasteful when the potential value of every seed that could be produced is considered.

The planting of so many cotton seeds in a hill has still another disadvantage from the standpoint of increasing valuable selections. The supply of seed when planted in the usual way often does not permit planting in more than one place, and the destruction of that planting, resulting from cold, hail, or any other cause, may mean the total loss of the progeny. A method making possible duplicate or triplicate plantings would reduce that danger of loss and at the same time afford an opportunity for studying the progeny under different conditions of soil and climate.

The waste of seed continues in all the later plantings of the seed produced in the progeny row. If the quantity is sufficient for a regular field planting, a mechanical planter is likely to be used, the seeds being drilled in as many rows as the supply will permit. The seeds thus planted produce under favorable conditions many more plants than it would be advisable to leave to mature. In thinning to the desired stand, 10 or more plants may be destroyed for every one left, depending upon germination, season, and spacing.

The loss thus experienced by the breeder during the three or more years that are required to obtain in quantity seed of his selection is enormous and makes plain the need of having less wasteful methods. Such methods would have a special importance in connection with the breeding of new varieties and would be of even greater practical importance in helping to maintain the uniformity of superior strains by continued selection. Methods that make possible a more rapid increase of select cotton would also be of special value to farmers, who do not, as a rule, practice selection because the process of producing sufficient quantities of pure seed appears to require too much time.

With the need of improved methods in mind, experiments were conducted in 1917 at the United States Experiment Farm at San Antonio, Tex., in cooperation with the Office of Western Irrigation Agriculture, the usual methods of increasing select stocks of cotton being compared with others in which a number of different nurse crops were used. The object of these nurse plantings was to determine whether as good a stand of select cotton can be secured where other kinds of seed supplied the lifting force necessary to break the soil crust as where only select seeds were planted. Could this be done, there obviously would be a material saving of select seed.

To discuss the observations made during the progress of these experiments is the purpose of this bulletin.

PLANTING DISTINCT TYPES OF COTTON.

One way in which seed of a valuable selection may be conserved is by planting it with seed of another variety of cotton which is so different that its seedlings can be distinguished and removed when the stage for thinning has been reached, thus securing the advantages of a heavy rate of seeding without the unnecessary waste of valuable seed. To do this successfully, however, a careful choice of varieties must be made. Obviously, the seedlings of each must possess distinctive leaf characters, so that in thinning only plants of the select strain may be left to grow; otherwise, the purpose of selection would be defeated, since the stock would be contaminated by crossing.

It is doubtful whether two Upland varieties could be found whose seedling characters are different enough to enable the breeder readily to distinguish between them with accuracy; but the fact that other nurse crops can be planted with safety renders unnecessary the selection of another variety of Upland for that purpose.

The danger in planting combinations of varieties of the same general type can be avoided by using varieties of distinct types. The seedlings of Upland and Egyptian cotton, for example, can be distinguished at a glance, thus enabling the breeder to remove either kind with ease, according to which variety he is increasing. The same is true also of Upland and Sea Island seedlings. But it is not possible to mix Egyptian and Sea Island cotton with impunity, as the seedlings of these two types are very difficult to distinguish. Both lack the red spot at the base of the cotyledons which is so characteristic of Upland varieties. Their cotyledons also are of a lighter tint of green than those of most Upland varieties and have a somewhat more distinctly waxy appearance.

Asiatic types of cotton are even more distinct from Upland varieties than is Sea Island or Egyptian, and since they do not cross with American types they may be found useful in nurse planting.

The value of Upland cotton as a nurse crop for Egyptian, or vice versa, was demonstrated in a test at San Antonio. Equal lots of delinted[1] Lone Star (Upland) and Pima (Egyptian) seed were thoroughly mixed and then planted by means of a mechanical planter in a row 264 feet long. When the seedlings were about 6 inches high it was possible to thin to an almost perfect stand of either variety in any section of the row (fig. 1).

PLANTING COTTON SEED WITH BEANS OR PEAS.

A very simple and effective method of avoiding the waste of select cotton seed and at the same time securing the desired crust-lifting force of several seedlings is to plant beans or peas with the cotton seed. This combination appeared especially advantageous at San

[1] See under "Delinting cotton seed for nurse planting" (p. 6).

Antonio, since the peas or beans came up before the cotton planted in the same hills, thus opening the way for the more tender seedlings. All things considered, however, beans seem to be better suited to this purpose than peas, owing to the habit of beans in raising their cotyledons above ground. A strong-growing variety of cowpeas does very well, but in leaving its cotyledons at the depth the seed was planted its lifting force is reduced.

In choosing a variety of beans for planting with cotton seed, the size of the beans should be considered. It appears that a variety of beans having large seeds makes a stronger early growth than one having small seeds; that is, the power to break through a soil crust

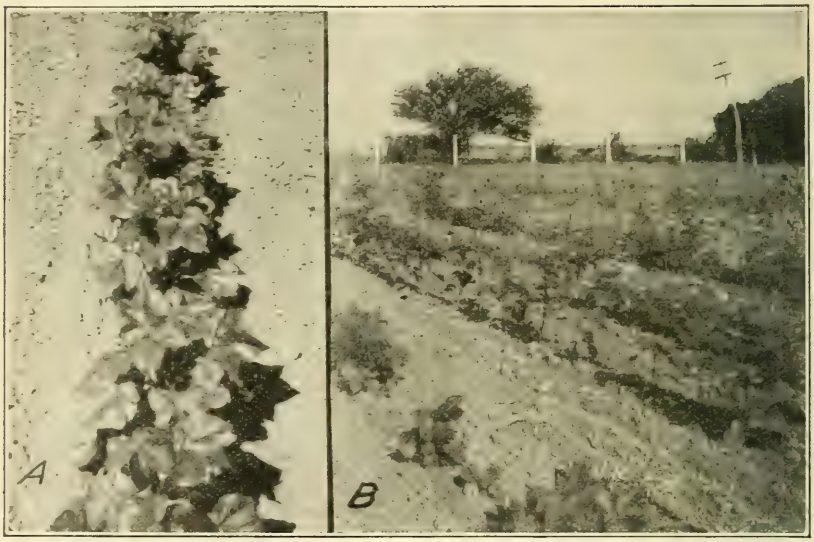

FIG. 1.—Upland (Lone Star) cotton planted as a nurse crop for Egyptian cotton, delinted seed of these varieties having been mixed in equal proportions and planted with a corn planter, using a 6-hole plate: *A*, Section of the row before thinning, when the plants were about 8 inches high, showing the uniform stand obtained; *B*, section of the row after thinning out all the Lone Star plants, showing Egyptian plants standing approximately 18 inches apart. In another section of this row an equally good stand of Lone Star cotton remained after removing all the Egyptian plants. The seedlings of these two types can easily be distinguished. (Photographed July 11, 1917.)

is greater. Thus, for example, the pinto bean was found to be better in this particular than the navy, and the navy better than the soy or tepary. But on the other hand, smaller beans have certain advantages over larger ones, as will be shown when the methods of planting are taken into account.

The early habits of growth of different varieties of beans and peas should also be considered. Large beans, like the pinto, and cowpeas, such as the Black-Eye variety, usually develop broad first leaves. This may be an advantage under some conditions, since the broad leaves would provide a certain protection for the cotton seedlings, but these overspreading leaves are likely at the same time to shade

the cotton seedlings, thus preventing normal growth. This habit of the Black-Eye cowpeas was especially noticeable in the plantings at San Antonio, the growth of the cotton seedlings in the cotton-pea hills being retarded more than in the all-cotton hills or the cotton-bean (tepary) hills. The tepary bean germinates quickly, seems to have sufficient lifting force, and makes a comparatively early growth. The soy bean might do well also, as its size is about what is desired from the standpoint of mechanical planting, but in the tests conducted at San Antonio it did not germinate satisfactorily. In one instance this may have been due to the fact that an inferior variety was the only one available. Later, seed of the Haberlandt variety was obtained and somewhat better results were secured.

Still another point to be given attention in choosing a variety of beans or peas for planting with cotton is the extensiveness of the root systems of the seedlings. This is especially important in so far as it bears on thinning out the bean or pea plants. It was observed that the pinto bean, for example, had developed a network of roots by the time thinning was considered advisable. These roots entangled those of the cotton plants in the same hills, making it necessary to exercise extreme care in thinning, to avoid injury to the cotton plants when the bean plants were pulled up. The cowpeas were not so bad in this particular, nor were the navy beans, but both were worse than the smaller beans, such as the tepary. This danger of injury to the cotton seedlings could, of course, be averted, if the case were such as to justify extreme care, by cutting or pinching off the bean or pea plants instead of pulling them.

RATE OF COMBINING COTTON WITH OTHER SEEDS.

The number of seeds planted in each hill should be varied, of course, according to conditions which are not controllable, such as germination, soil, and climate. Probably the best that can be done is to plant enough seed to provide against poor germination and the possible crusting of the soil. While it may not always be practicable, owing to a limited quantity of seed, to determine the percentage of germination of select cotton, it should be ascertained when conditions permit. It is always practicable to make such determinations with seed of the nurse crops. Knowledge of the viability of these seeds would suggest the rate of planting to employ.

If a maximum increase of a selection is desired, one select seed and three or four beans will be found to give good results. A perfect stand can not, of course, be expected, as it is not likely that all the select seed will germinate. This method of planting was followed at San Antonio (fig. 2) where Tuxtla cotton progenies were planted with pinto beans, and a germination of 90 per cent was obtained, or 99 plants from 110 seeds. If two cotton seeds instead of one had been planted in each hill, it is likely that an even better stand would

have resulted, but in that case plants could have been grown in only 55 instead of 99 hills.

If the breeder were interested in obtaining for comparative study a uniform stand of his progenies rather than maximum increase, two cotton seeds in each hill, with as many nurse seeds as previous determinations on percentage of germination would indicate, should be ample provision against almost any condition that may arise to prevent the emergence of the seedlings. The chances are good that at least one of the two select seeds planted will grow, and one select plant in a hill is all that ordinarily is required, especially where further selection is to be made. The beans, peas, or other cotton seeds planted in the same hill could be depended upon to help the select

FIG. 2.—Cotton progenies planted with pinto beans. One cotton seed and two or three beans were planted in each hill. In 11 of the 110 hills planted no cotton plants came up, owing to the failure of some seeds to germinate. Had two cotton seeds been planted in each hill, a perfect stand might have been secured; but by so doing only 55 instead of 99 hills could have been grown from the same quantity of seed and the maximum increase would not have been obtained. (Photographed July 3, 1917.)

plant through the soil. If the select seed should have a lower germination than 50 per cent, it would, of course, be advisable to plant accordingly.

The rate of planting to be employed when further increase plantings are made depends upon the seed combination, percentage of germination, and the kind of planter used. This feature will be discussed more in detail in another place.

DELINTING COTTON SEED FOR NURSE PLANTING.

The planting of cotton seeds with beans or peas is greatly facilitated by delinting them. This can be done with ease and little expense by immersing them for about 2 minutes in commercial sulphuric acid. After being delinted they should be washed in running water for at least 10 minutes in order to remove all the acid.

This treatment does not seem to injure the seed and may actually be beneficial, especially as regards germination. Moreover, it was found while treating seed in this manner that during the washing process the seed could be very easily separated according to weight. That it would be advantageous to remove the lighter seed was indicated by the results of several germination tests under field and laboratory conditions. Further experiments along this line are in progress.

Among the advantages to be gained by delinting cotton seeds which have a direct bearing on the present discussion may be mentioned the ease with which they may be handled in hand dropping and the possibility of using a corn planter in making increase plantings. It is a simple matter to take one or two delinted seeds from a bag, but it is more difficult to take only that number when not delinted, as the fuzzy seeds tend to adhere to one another. For the same reason, it is hardly possible to mix thoroughly the fuzzy seeds of two varieties of cotton or of one variety with beans or peas. Furthermore, there probably is no machine that could be used effectively in planting seed mixtures of which fuzzy seed formed a part. But the corn planter, as will be shown, can be used to good advantage when the cotton seeds are delinted.

METHOD OF PLANTING IN HILLS.

Much improvement is possible in the methods of hill planting that are ordinarily practiced. The usual method is for one man to open a shallow hole with a hoe and another man to drop the seeds, the first man covering them with the hoe and compacting the soil about the seed with the hoe or the foot. The chief objection to this method is that considerable care must be exercised to guard against planting the seeds too shallow or too deep. Even under the most favorable circumstances there is usually rather too much variation in this respect. Moreover, it is not always practicable to cover the seeds with moist soil, dry soil often rolling to the seeds before proper covering can be accomplished.

This method is further complicated where nurse plantings are made, though this is not so serious a matter if the cotton seeds have been delinted. It is necessary for the man dropping the seeds to drop the select cotton seed with one hand and the beans or peas with the other. This operation requires a little more time than where cotton alone is being planted, but the gain through the conservation of select seed very likely would more than offset the loss of time involved.

In the experiments at San Antonio the writer found that a simple hand corn-planting device could be used advantageously in planting cotton or cotton-bean or cotton-pea combinations. This planter was designed by the Office of Corn Investigations and was being used in planting some experiment plats with corn on the San Antonio farm when it came to the writer's attention. Briefly it may be described as follows: A wooden strip, 3 inches wide and 36 inches long

(fig. 3), is faced with galvanized iron so shaped as to form two parallel tubes running the entire length of the board. At the top end the tubes are funnel shaped. At the bottom end they empty into a kind of hopper. To this hopper a spring and a lever are attached, by means of which the mouth of the hopper can be opened or closed as desired. At the top of the back of the baseboard a handle is attached. At the bottom there is a flange by which the depth of planting can be regulated.

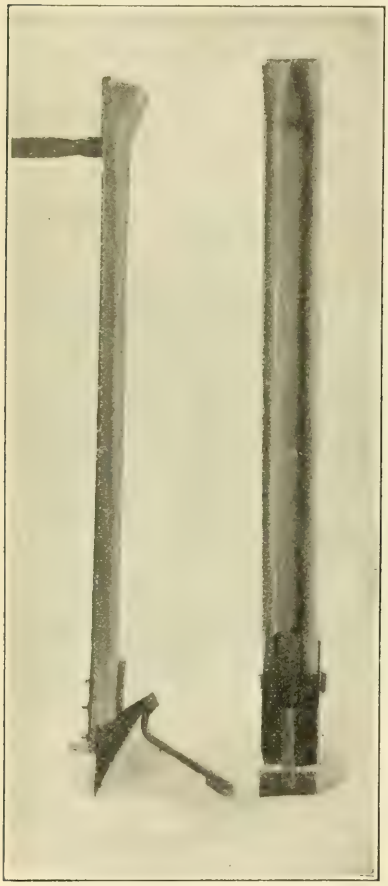

FIG. 3.—Hand corn planter, designed by the Office of Corn Investigations, successfully used at San Antonio in 1917 in planting delinted cotton alone and in combination with peas and beans. The use of a planter of this type appears to have a number of advantages over the usual method of hand-dropping progeny rows. (Photographed July 2, 1917.)

One man can operate the planter very easily. Rapid progress can be made if the seeds to be planted are carried in a pouch attached to each hip, cotton seed in one and beans or peas in the other. One kind of seed can be dropped into one of the tubes and the other kind into the other tube. Then, by thrusting the nose of the planter into the ground at a marked point and giving the planter a forward lifting movement, the seeds may be deposited at a uniform depth in the moist soil. The spring on the hopper closes the latter automatically as the planter is lifted again. As the operator steps forward to plant the next hill he can step lightly on the hill just planted, thus compacting the soil about the seeds, meanwhile dropping more seeds into the tubes, to make ready for further planting.

METHOD OF PLANTING IN DRILLS.

Nurse planting in drills is practicable only with delinted cotton seeds, for reasons already given. With these it becomes a simple operation, since the ordinary corn planter can be used.

Mixtures of Lone Star (Upland) and Pima (Egyptian) cotton, cotton and cowpeas, and cotton and beans were planted successfully with a corn planter at San Antonio in 1917 (figs. 1 and 4). In the

first instance, delinted Lone Star and Pima were mixed in equal proportions and planted through a 6-hole corn plate. The stand obtained made it possible in thinning to leave the plants of either variety about 18 inches apart. In the other rows also it was possible in removing the beans or peas to leave the cotton plants approximately 18 inches apart, though the actual distance varied with the number of holes in the corn plates used. The total number of plants destroyed in thinning these rows varied between 300 and 500 to the row, 264 feet long. Of these, only 7 to 25 per cent were cotton plants, the remainder, 75 to 93 per cent, being peas or beans. This loss of cotton plants was not more than one-fifth (in one case, only a tenth)

FIG. 4.—Cotton planted with a nurse crop by means of a corn planter. Only 7 to 25 per cent of the plants removed from these rows when thinned were cotton plants, 75 to 93 per cent being pea or bean plants. The total number of plants destroyed in each row, 264 feet long, varied from 300 to 500. In the check rows on each side of this plat, which were planted in the usual manner, using an ordinary cotton planter, the number of cotton plants taken out was 453 and 573, respectively. This represents 75 and 80 per cent of the total number of plants in the rows. Not more than one-fifth and in one instance fewer than one-tenth that number of cotton plants were lost where nurse plantings were made. The number of plants in each of the rows shown above approximated 140, the extremes being 120 and 150. The average distance between the plants was 18 inches, the actual distances varying somewhat with the number of holes in the corn plates used. (Photographed July 11, 1917.)

as great as that recorded in check rows planted in the usual manner on each side of the nurse plantings. In thinning these checks, 453 and 573 plants, respectively, were destroyed, representing a loss of 75 and 80 per cent of the total number of plants in the rows.

In using a corn planter for these plantings a nurse crop with seeds about the size of the delinted cotton seed was found to be best suited to the method. Large beans were cracked to some extent even by the large-hole plates, and they would not feed through the plates containing more and therefore smaller holes. The 6-hole plates appeared to feed at about the proper rate in some instances, but it is probable that a 9-hole or 10-hole plate would be preferable if small

beans, such as the tepary or soy, were used as the nurse crop. A 9-hole plate was used in planting a mixture of cotton and soy beans, but owing to the low percentage of germination of the latter the stand secured was rather poor.

In making these plantings the seeds were mixed on the basis ratio of 1 to 1. Some rows were planted with mixtures containing less than half cotton, but none containing more than that amount. Where a 1 to 2 mixture was used the stand of cotton was not as good as desired. However, the cotton used had a relatively low percentage of germination. With a variety giving a better germination the 1 to 2 mixture might prove to be satisfactory. Here, again, the rate of mixing must be determined in each instance on the basis of the percentage germination of the different seeds used and the size of the corn plates used in planting.

Under specially favorable conditions it may not be necessary to plant a nurse crop in order to conserve select cotton seed. Mr. D. A. Saunders, of the Bureau of Plant Industry, obtained very satisfactory stands in 1917 at Greenville, Tex., by planting delinted Lone Star cotton seed alone with both a 4-hole and a 5-hole corn plate. The seeds were dropped 12 to 18 inches apart, and one or two plants grew in each hill, as the soil conditions were favorable to good germination. As no thinning was necessary, a maximum increase of seed resulted. But under most conditions the chances of obtaining a good stand would be greater were a nurse crop used.

ADVANTAGES IN NURSE PLANTING.

The chief advantages to be gained by using a nurse crop in increasing select cotton seed are the saving in select seed and the resultant possibility of more rapidly increasing the supply of such seed.

The saving involved in planting seed mixtures in hills, as suggested herein, might easily amount to 30 or 60 per cent where three to six seeds are planted in each hill. In subsequent increase plantings the saving might be even greater, as most of the plants removed in thinning would be nurse plants and not select cotton plants.

The following hypothetical example will serve to illustrate these advantages of nurse planting: Assuming that from a select plant there has been gathered a quarter of a pound of seed cotton containing 600 seeds and that all these seeds are to be planted in a progeny row, the number of hills that may be planted will vary between 100 and 600, according to whether the seeds planted in each hill number six, five, four, three, two, or one. Assuming further that only one plant in a hill is to be left to mature, and that each will produce, as did the parent plant, 600 seeds, then on the basis of 3,600 seeds to the pound, the increase in seed will vary from 17 to 100 pounds, depending on the rate of seeding used. (Table I.)

TABLE I.—*Comparative seed increase of cotton when planted in progeny rows, the number of seeds in a hill being varied from one to six.*

Rate of planting.	Number of hills.	Seed produced.	Rate of planting.	Number of hills.	Seed produced.
		Pounds.			*Pounds.*
6 seeds to hill	100	17	3 seeds to hill	200	33
5 seeds to hill	120	20	2 seeds to hill	300	50
4 seeds to hill	150	25	1 seed to hill	600	100

In carrying the example farther, it is sufficient to compare only the 4-seed and 2-seed rates. In the one case, 600 cotton seeds might be planted four in a hill in the usual manner, making a total of 150 hills. In the other, 600 cotton seeds, if nurse planted two in a hill, would give 300 hills in all. After thinning out the surplus plants in each hill, there would remain, therefore, 150 cotton plants in the first instance and twice that number, or 300, in the second. The total production of seed from the 150 plants would be 25 pounds, as compared with 50 pounds from the 300 plants, a gain of 100 per cent. If nurse planting were practiced the second year, the gain would become 400 per cent. The 25 pounds of seed produced by the progeny row planted in the usual way would, for example, plant 1 acre if planted with a cotton planter, while the 50 pounds from the nurse-planted progeny row would plant 4 acres if delinted, mixed in equal proportion with beans or peas, and planted with a corn planter. By carrying this procedure through the third year, as shown in Table II, it would be possible to plant in the fourth year only 3,040 acres with the stock of seed increased in the usual manner, while with the nurse-planted stock it would be possible to plant 16 times as much, or 48,646 acres.

TABLE II.—*Comparative increase of seed when select cotton is planted in the usual way and under nurse planting.*

Method of planting.	First year (progeny row).			Plantings at the rate of 25 pounds per acre.				
				Second year.		Third year.		Fourth year.
	Cotton seeds in a hill.	Number of hills.	Seed produced.	Area planted.	Seed produced.	Area planted.	Seed produced.	Area planted.
			Pounds.	*Acres.*	*Pounds.*	*Acres.*	*Pounds.*	*Acres.*
Usual	4	150	25	1	1,382	55	76,010	3,040
Nurse (half cotton and half nurse crop)	2	300	50	4	5,528	440	608,080	48,646

It is reasonable to believe, therefore, that at least one and probably two or three years could be gained in increasing select cotton seed if the method of nurse planting herein described were followed. Such a gain would more than repay the extra time and labor expended, as well as the cost of the beans or peas. This would often be true even if the saving of seed were much less, for there is no basis for estimating the value of a particularly desirable selection of cotton.

The saving of seed through nurse planting makes it possible also to duplicate or triplicate the planting in other fields. Such a precaution would provide against the total loss of a selection because of hail, floods, or other factors. Duplicate or triplicate plantings also afford an opportunity to study the behavior of the selection under a wider range of soil and climatic conditions.

While this method of nurse planting seems to be especially well suited to the needs of breeders, it is possible also that such a method would prove advantageous to the farmer who pays a high price for a small quantity of select seed. It appears that he could thus increase his seed to an extent that would enable him to plant his entire farm one or two years sooner than if he employed the usual method of increase. In order to avoid all danger of crossing, however, it probably would be best for farmers to use beans or peas as a nurse crop instead of different types of cotton.

A way in which nurse planting small stocks of cotton seed could be of immediate practical importance is in connection with the congressional distribution of seed. The method of distribution is, first, to send out quart packages of superior seed and follow these the second year with half-bushel lots to those farmers who show by their care of the quart samples and their report on the behavior of the varieties the proper interest in establishing and maintaining a seed supply. By nurse planting his half bushel of seed a farmer could obtain a much greater increase of the variety than would be possible by the usual methods of planting.

SUMMARY.

The present methods of increasing select cotton are wasteful. The number of seeds planted far exceeds the number of plants that can be left to mature. Usually 50 to 75 per cent of the seedlings are destroyed at the time of thinning.

The method herein suggested substitutes other seeds, those of a distinct type of cotton or of beans or peas, for those select cotton seeds that produce surplus plants. Thus, in thinning, the number of select seedlings that have to be destroyed is greatly reduced, most of the surplus plants representing other seeds (beans or peas). These plants are as effective as the select plants in breaking through a soil crust, which is the chief purpose of planting at a high rate.

At San Antonio, Tex., where experiments were conducted, successful plantings of seed mixtures were made by improved methods in hills and in drills with both hand and mechanical corn planters. The use of corn planters for planting cotton seed was made possible by delinting the cotton with sulphuric acid.

By utilizing this method of nurse planting in increasing cotton selections, it is believed that a gain of at least one year and probably three years in time can be effected, as 30 to 60 per cent more land may be planted each year with select seed than is possible by present methods.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 669

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. November 18, 1918

THE MANUFACTURE OF NEUFCHÂTEL AND CREAM CHEESE IN THE FACTORY.

By K. J. Matheson and F. R. Cammack,

Of the Dairy Division.

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IMPORTANT FACTORS IN SUCCESSFUL PRODUCTION.

When Neufchâtel and cream cheese are manufactured on a commercial scale it is important to use methods that will assure a uniform, attractive, and wholesome product. Very little detailed information dealing with the making of Neufchâtel cheese upon a factory scale is available. In fact, in many cases the trade secrets of this branch of the dairy industry have cost manufacturers large sums of money. In outlining the methods of making the cheese several factors should be taken into consideration:

1. Quality of raw material.
2. Healthfulness of the cheese.
3. Economical use of labor and equipment.
4. Reduction of losses to a minimum.
5. Conditions influencing the keeping quality of the cheese.

QUALITY OF MILK.

Formerly starters were not used in the making of Neufchâtel cheese on a commercial scale. Under such conditions a mixture of night's and morning's milk was deemed more desirable than fresh milk. With this system the normal fermentations were often superseded by gassy fermentations in warm weather and especially in the

spring months. This resulted in injury to the quality of the cheese and also greatly reduced the yield. At present practically all manufacturers pasteurize the milk, necessitating the use of a starter, but thereby preventing abnormal fermentations and insuring a uniform product from day to day. In either case, whether pasteurized or not, a sure and rapid development of the acidity is necessary in order to make the cheese successfully.

FACTORY SANITATION.

The room where the milk and cheese are handled should be constructed with a view of maintaining strict cleanliness. Cement walls and floors are almost imperative if they are to be kept in a sanitary condition by daily washing and flushing. The water used in the factory should be filtered or should be obtained from a source free from all possible contamination. The equipment and utensils in a soft-cheese factory should be so arranged and constructed as to be easily cleaned. Only such apparatus as is daily needed to facilitate the rapid and proper handling of the milk and cheese should be left in the workrooms. Precautions should be taken also to have all heating and cooling pipes below rather than above the place where the cheese is drained, so as to guard against falling particles of dirt and rust. All windows and doors of the factory should be provided with fine-meshed screens, to keep out flies and other insects.

THE MANUFACTURING PROCESS.

The process of making Neufchâtel and cream cheese in the factory is essentially the same as that on the farm, as described in Farmers' Bulletin 960. The handling of large quantities of milk, however, requires more elaborate and extensive equipment in order that the numerous operations may be performed rapidly and efficiently. Vats of about 600 gallons' capacity are commonly used for heating the milk. After a preliminary warming with the addition of rennet and a starter, the milk is run directly into shotgun cans holding about 4 gallons each, which are filled by means of a connecting pipe. The cans are then set side by side in a concrete-walled room, commonly known as a cellar, or, if the room is small, placed one upon another. Along the sides of the cellar are steam pipes that regulate the temperature so as to induce proper fermentation. After the milk has ripened for 15 to 18 hours the coagulum is poured upon draining cloths supported by means of special drain racks placed side by side. After a large part of the whey has drained off, the corners of the cloths are folded together, tucked in, and the resulting bags placed on ice in order to prepare the curd for pressing. After pressing, the curd is salted, ground by means of a roller or

other mixing device, and sent through a special molding machine which molds and cuts the cheese to the proper size. The cakes of cheese are then wrapped in tin foil or aluminum foil and boxed for shipment.

The details of the various steps of manufacturing are as follows:

PASTEURIZATION.

The principal reason for pasteurization in the making of soft, unripened cheese is to remove the danger from disease-producing organisms. In working with cheeses of the Neufchâtel group, Schroeder[1] found that of 32 samples of Neufchâtel cheese tested none were infected with tubercle bacilli; of 31 samples of cottage cheese tested 1 was infected with tubercle bacilli; of 131 samples of cream cheese tested 18 were infected with tubercle bacilli. In each case the tubercle bacilli found were of the bovine type. The desirability of pasteurizing milk for the making of such cheese is therefore evident.

If proper pasteurization is practiced, together with the use of an efficient starter, there are a number of other advantages, which may be enumerated as follows:

1. The cheese produced is more nearly uniform.
2. Gassy fermentations accompanied with excessive curd losses are prevented.
3. The yield is slightly increased.
4. Cheese of uniformly higher quality with less danger of bitterness when aged is insured.
5. Milk for making the cheese can be held for a longer time.

It is unquestionably true that cheese made from unpasteurized milk and without the use of a starter possesses a characteristic aroma at first not so readily observable in the pasteurized cheese, but the difference becomes less marked in the course of a few days. The initial aroma may be produced by some volatile substance that is partially driven off in the course of the pasteurization. To obtain a safe product, however, it seems desirable either to use milk from tuberculin-tested cows, or to pasteurize the milk and use a starter, even though the initial flavor is sacrificed to a slight extent.

Milk may be pasteurized by either the holding or the flash system of pasteurization, although the first mentioned is the better. Where new factories are being established, the holding system is always recommended. With the flash system the milk is heated to 165° or 170° F. for a moment and then cooled to the desired temperature. With the holding system the milk is heated to 145° F. and held at that temperature for 30 minutes. For small-scale operations the milk may be pasteurized by heating in a jacketed vat and cooled by water without being removed from the vat. For large operations the most economical kind of pasteurizer not only pasteurizes but cools and

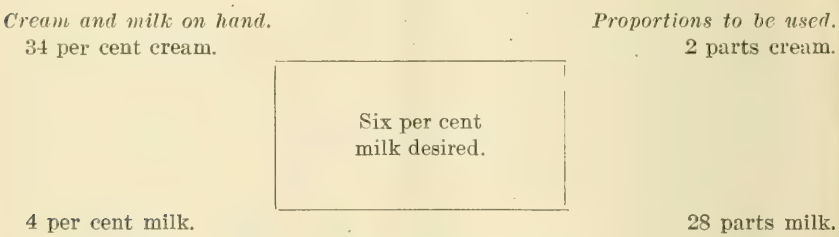
[1] "Public Health Studies Concerning Cheese," a paper read before the International Association of Dairy and Milk Inspectors by E. C. Schroeder, at Washington, D. C., Oct. 17, 1917.

mixes the milk. From the standpoint of quality of the cheese there is practically no difference between the two processes; and in either case the milk, after pasteurization, should be cooled quickly to 80° F. for Neufchâtel or 83° F. for cream cheese. It is possible so to regulate the flow of brine or water in the coil as to bring the temperature of the milk to the desired point without rewarming.

STANDARDIZING THE MILK.

It is desirable to use whole milk testing 3½ to 4 per cent for making Neufchâtel, while for cream cheese sufficient cream should be added to the milk to bring the resulting mixture to from 6 to 8 per cent fat. In some factories the milk is skimmed and cream enough is added to obtain a 6 or 8 per cent milk. The milk always should be standardized before pasteurization.

With 4 per cent milk available, if one-third of the quantity is run through a cream separator and the resulting cream added to the remaining two-thirds, milk testing approximately 6 per cent is obtained. If the milk tests only 3 per cent it will be necessary to separate one-half of the quantity and add the cream to the remaining half. For extensive operations it is advisable to use a Babcock tester to standardize the milk accurately. The following diagram illustrates an easy method of determining the proportions of milk and cream of different per cent of fat needed to make up 6 per cent milk:



The desired per cent of fat, in this case 6, is placed in the center of the square. At the upper left-hand corner the per cent of fat in the available cream is placed, in this instance 34. Immediately below, in the lower left-hand corner, the per cent of fat in the available milk is placed, which in the instance cited is 4. Next subtract diagonally across the square the smaller from the larger number and place the difference in the upper and lower right-hand corners respectively. In the upper right-hand corner 2 represents the number of parts of 34 per cent cream, and in the lower right-hand corner 28 represents the number of parts of 4 per cent milk necessary to make 6 per cent milk.

If it is desired to make up a definite quantity of 6 per cent milk, for example 60 pounds, the procedure is as follows: Two added to

28 makes a total of 30 parts of 6 per cent milk. The quantity of 34 per cent cream necessary is $\frac{2}{30} \times 60$, or 4 pounds, while the quantity of 4 per cent milk is $\frac{28}{30} \times 60$, or 56 pounds.

STARTERS.

A rapid development of acidity is necessary. The addition of commercial lactic starter aids in hastening subsequent drainage and checks objectionable fermentations. From 1 to 1½ per cent of starter is recommended for best results. The curd of the starter should be broken up into a fine condition before adding it to the milk. When pasteurization is practiced sufficient starter must always be added to make the development of acidity certain, and there is little danger of developing the acidity too rapidly. A slow-acting or impure starter is sure to cause disappointment and losses.

Too much attention can not be given to keeping the starter vigorous and pure. Satisfactory starters may usually be obtained from any reliable starter company. The method of handling the starter on a factory scale may be outlined as follows:

1. Place a clean agitator in a shotgun can that is bright, clean, and free from rust. (A 2-quart fruit jar and a long-handled spoon will be satisfactory for a small-scale operation.)

2. Put a quart of fresh skim milk in the can or jar and heat to 175° F. and hold at that temperature for 30 minutes.

3. Cool the milk to 75° F. and add the entire contents of a package of solid or liquid commercial starter, stir vigorously, cover, and set away until coagulation takes place.

4. Heat several gallons of skim milk in a starter can or in a 10-gallon milk can to 175° F. and hold at that temperature for 30 minutes, then cool to 75° F.

5. By means of an agitator break up the coagulum in the shotgun can into finely divided particles and then pour it into the starter can or 10-gallon milk can containing the pasteurized skim milk.

6. Each day repeat steps 4 and 5, but instead of preparing a fresh starter as in 1 and 2, use about 1 quart of the starter prepared the day before to each 10 gallons of pasteurized milk.

TEMPERATURE FOR SETTING.

The temperature at which milk is usually set to ripen is 80° F. for Neufchâtel and 83° F. for cream cheese. In certain factories the milk is set at 78° F. and the temperature is raised several degrees after coagulation has taken place. Experiments have demonstrated that temperatures from 75° to 85° F. for setting may be safely used. The object of the higher temperatures for setting is to favor a rapid coagulation, which in a measure reduces subsequent fat losses by quickly checking the rising cream. The temperature of setting de-

termines to a great extent the softness or firmness of the curd. Under normal conditions it requires from 45 to 60 minutes to curdle milk; the exact time to set a given lot of milk will, of course, depend upon the temperature, acidity, rennet, and composition of the milk.

RENNET OR PEPSIN.

Commercial liquid rennet, one-third of an ounce, or five-sixths of a gram of powdered pepsin, is added to each 1,000 pounds of milk. The rennet should be diluted in a half pail of cold water, or if pepsin is used, the powder is first dissolved in a little cold water and then handled in the same manner as rennet. There is some advantage, in the case of cream cheese, in using half an ounce of liquid rennet or 1 gram of powdered pepsin per 1,000 pounds of milk instead of the quantities specified. Sometimes powdered rennin is used as a curdling agent, in which case the quantity depends upon its strength. One gram of powdered rennin is usually equivalent to 4 or 5 grams of liquid rennet.

The powdered pepsin or powdered rennet should be weighed on an accurate balance and then dissolved in 20 times its weight of water warmed to 105° F. The solution is then poured through a strainer cloth into a dipper of cold water in order to remove any solid particles. Under no circumstances should powders be dissolved until needed for use. Pepsin has given nearly as satisfactory results as rennet and is less expensive.

All liquid curdling agents should be kept in a cold place in dark-brown bottles which are kept tightly corked.

FILLING THE CANS.

After being pasteurized and cooled down to 80° or 83° F. and the curdling agent added, the milk is drawn off from the faucets of the setting vats, which should be placed close to the cellar. The work must be conducted rapidly so that the contents of the vat may be removed within half an hour, to avoid agitating the milk after it has begun to set. Unless a sanitary connecting pipe is used in filling the shotgun cans it requires several workers to remove them as rapidly as they are filled. If not very carefully cleaned and thoroughly sterilized daily, the connecting pipe can not be kept in sanitary condition, and its use should be avoided. The shotgun cans are usually filled in the forenoon in order that the curd may be ready for drainage the following morning.

DUMPING THE CURD.

The following morning, if the fermentation or ripening has progressed satisfactorily, there should be about a quarter of an inch of whey, which is sufficient to form a scum on the surface of the curd. This is a fairly accurate sign of a proper fermentation, while

the absence of whey on the surface and a puffed appearance of the curd indicate either a poor starter or improper pasteurization.

Usually between 5 and 6 a. m. the cans of curd are poured upon the cotton-sheeting draining cloths which were spread over the racks the previous evening. In emptying the shotgun cans the contents are poured carefully against the side of the drain cloth rather than in the center, in order that any cream which may have risen may not be leached unnecessarily by the rapidly escaping whey. The contents of each can should be so poured as to break the jelly-like curd or coagulum as little as possible. No curd should be left adhering to the sides of the can. If the curd has a tendency to stick,

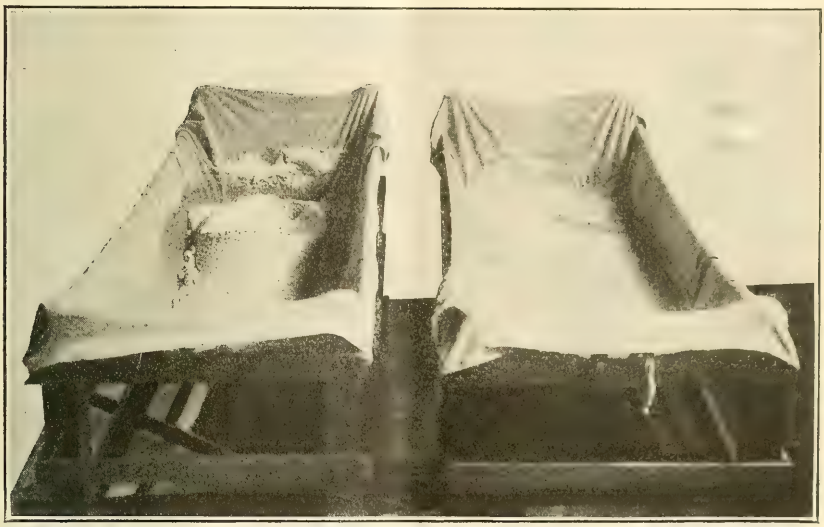


FIG. 1.—Gassy curd and normal curd.

which is more often the case when pasteurized milk has been used, it may be loosened by striking the can against the floor.

When emptied, the shotgun cans should be washed immediately, first in cold water and then scrubbed thoroughly in hot water containing washing powder, after which they should be rinsed again with warm water and thoroughly steamed.

The cans may be transported from the place of setting to the draining racks either by overhead trolley or by hand; in either case several men are needed to do the work promptly.

DRAINING.

The draining should be completed in about three hours, depending somewhat upon the kind of cheese, for cream-cheese curd drains much more slowly than partially skimmed Neufchâtel curd. A gassy curd drains much more rapidly than a normal curd, and the losses of curd are excessive.

For the first two hours the coagulum is left undisturbed, in order that the free whey may escape and that the curd may acquire a consistence that is not readily broken to pieces. Finely broken curd is unfavorable for drainage. During the last hour the curd is worked toward the center of the cloth by means of a tin or wooden ladle. The ends of each drain cloth are then loosened and the cloth and its contents placed in a boxlike rack which rests upon a wide, flat board, after which first the sides and then the ends of the cloth are alternately folded over the curd. The end pieces of the cloth are then tucked in, giving each drain cloth and contents a baglike appearance.

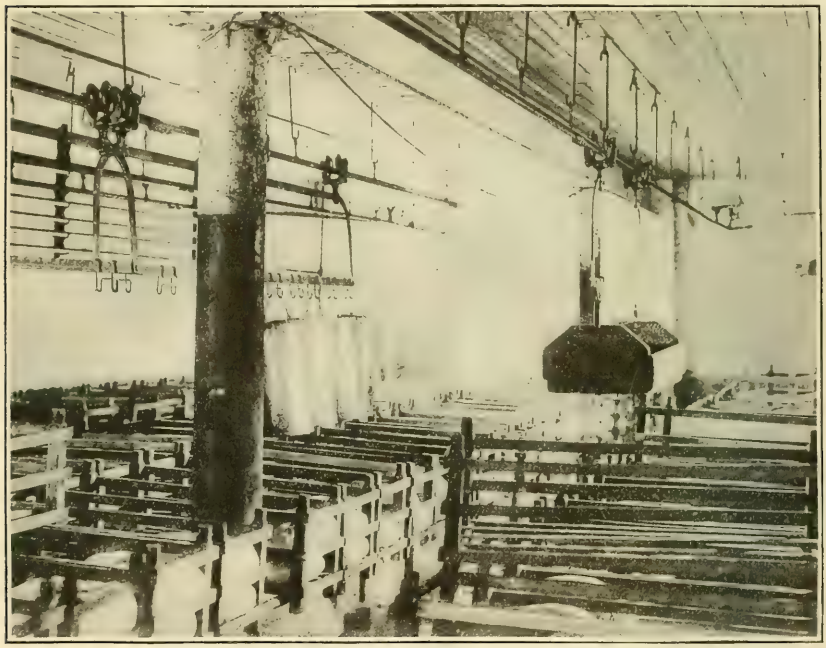


FIG. 2.—Draining equipment in a modern factory.

After the preliminary draining just described the manner of handling the curd in the bags will depend upon how soon they are to be pressed. If the cheese is to be pressed the same day the procedure is as follows: After draining for 30 minutes the bags are piled one upon another in a rack, where they remain for about half an hour, after which the bags from two racks are placed in a single pile. Usually two or three racks are placed one above another and the bottom sticks are removed. For about an hour the three or four dozen bags remain undisturbed, save for a rearrangement which occurs once during the period, when the position of the bags is reversed.

When the curd is not pressed until the following day, the bags of curd are placed on ice at once.

ICING.

When the cheese is made in large quantities, the bags of curd are always in alternate layers of cracked ice prior to pressing. Usually a large rectangular box about 3 feet high, 8 feet long, and 3 feet wide is provided in which alternate layers of ice and bags of curd are placed. Under the first system of draining, the curd may be cool enough in a few hours to permit pressing, while, if the pressing is not to be done until the following day, the bags are left on ice overnight. The object of chilling is to harden the curd so that it does not so readily pass into the meshes of the drain cloths and interfere with draining, and also to give it sufficient body to be molded.

PRESSING.

After chilling, the bags of curd are placed in a lever press provided with ratchet and pawl, where firm but increasing pressure is applied gradually, in order to allow the escape of whey and incorporated air. Without this precaution there is danger of applying so much pressure as to break the drain cloths, which is more liable to occur at first with a comparatively light pressure than later when more pressure is applied. The pressing should continue until a yield of 18 to 20 pounds per 100 pounds of milk is obtained for cream cheese and 14 to 16 pounds for Neufchâtel cheese. This is equivalent to a yield per bag (30-pound unit of milk) of 5½ to 6 pounds of cream cheese and 4½ pounds of Neufchâtel. The acidity of the whey at the beginning of pressing is about 0.50 to 0.55 per cent.

WORKING AND SALTING.

After pressing, the cakes of curd are salted and worked by machinery into a more or less buttery consistence. This is accomplished by either of two machines, namely, (1) a grinding machine consisting of a hopper and two grinding cylinders, which are rotated in opposite directions by power, and (2) a bread mixer or similar mixing device, which consists of a tilting mixing box provided with knives revolving in opposite directions, operated by electric power. Salt is sprinkled on the cakes of curd, usually at the rate of 1 pound of salt to 100 pounds of curd. Some manufacturers salt as high as 1½ pounds to 100 pounds of curd; the amount of salt to use will of course depend upon the trade demands. Either of the machines mentioned is used to distribute the salt uniformly throughout the curd; the rest of the work necessary for a cheese of smooth consistence is to be performed by the spiral screw of the molding machine. The mixer type gives the curd a very soft consistence, so much so that it must be kept at a low temperature for several hours or overnight before it will be in a fit condition for molding. On the other hand, the grinding machine is less vigorous in action and handles

the curd more rapidly. In this case, after coming from the machine, the curd is ready to mold at once.

The cheese, as it comes from either the mixing or the grinding machine, is transferred to the refrigerator or to the molding machine in large cans or square wooden boxes holding from 80 to 100 pounds.

MOLDING.

A special machine designed for molding may be purchased and is in use in most of the large soft-cheese establishments. The curd is placed in a hopper from which a spiral screw forces it into a molding tube that delivers it to an automatic cutting device, which cuts the curd to the desired lengths for wrapping. Operated by skilled work-

FIG. 3.—Curd mixer and press.

men with the curd in the proper condition, the machine can mold and cut from 2,400 to 2,500 Neufchâtel cheeses an hour, and cream cheese in like proportion.

Two conditions are necessary for the proper working of the machine: (1) The curd must have the proper temperature, about 50° F.; (2) the curd must not contain too much moisture. A yield of from 18 to 20 pounds of cheese per 100 pounds of milk seems most satisfactory. With a lower yield the cheese runs through with difficulty; with a higher yield it is often too mushy to handle satisfactorily. Only one person is actually required to operate the machine, although several are necessary for wrapping. The curd should be worked from the hopper into a feed screw by means of a ladle. The issuing roll or ribbon of cheese is automatically cut to the desired size and car-

ried by means of a canvas conveyer, which is about 10 inches wide and 12 feet long, to the place of wrapping. Along either side of the conveyer are seated girls who dexterously remove, wrap, and replace the cakes of cheese. At the end of the conveyer the wrapped cakes are removed by a girl who places them in suitable boxes.

Pimiento-cream, or pimiento-olive cream cheese is handled a little differently. The curd and pimiento peppers are first run through a meat chopper and are then ready to be sent through the molding machine. A cylindrical Neufchâtel attachment in the shape of a tube sufficiently small to pass to the bottom of a 4-ounce glass jar is used for filling purposes. The curd is forced into the jars until they are completely filled, when they are scraped over the end of the attachment so as to give a smooth appearance to the surface of the end and leave few if any air spaces throughout the curd mass. Sometimes the tops of the jars are leveled off by means of a milk cap.

FIG. 4.—Wrapping and packing Neufchâtel cheese as it comes from the molding machine.

METHODS OF PACKING.

The cakes of Neufchâtel and cream cheese are wrapped in tin or aluminum foil with parchment paper. The foil when purchased is cut to the proper size and stamped with the desired brand and weight. The commercial life of the cheese may be considerably lengthened by skillful and careful wrapping. Each wrapper should be drawn securely about the cheese before it is placed in the wooden box ("flat") in single layers, and each package should be well shaped and present a bright, attractive appearance.

Cream cheese is packed a dozen in each box, but the Neufchâtel cheese is marketed in boxes containing 1 or 2 dozen cakes, and sometimes 25, to the box.

Often the cheese is shipped in tubs or cans from the factory to the distributing center before molding. Such a system reduces labor

and freight charges to a minimum, and the keeping quality of the product is likewise improved.

The glass jars of pimiento or olive-cream cheese are first covered with paraffined disks of paper cut to the proper size and then with screw caps.

SIZE OF PACKAGES AND PRICES.

Standard Neufchâtel packages in tin foil are about 1½ inches in diameter and 2½ inches long, and weigh from 2½ to 3 ounces. At present they retail at about 7 cents a package, while the wholesale price is about $1.40 a box of 25 cheeses.

The cream-cheese packages in foil are 3 inches by 2 inches by 1 inch and weigh from 3 to 3½ ounces. Such packages retail at about 15 cents each; the wholesale price is from $1.30 to $1.40 a box of 12.

The pimiento cheeses, in glass jars, weigh 3½ ounces net and retail at about 15 cents a jar.

The size of packages has been fixed by experience. Larger packages have been tried by manufacturers, but the practice was quickly discarded as being impracticable. A small package of cheese may be consumed at a single meal, whereas larger packages would require special and effective refrigeration to prevent the development of mold and deterioration of flavor.

YIELD OF CHEESE PER HUNDRED POUNDS OF MILK.

The yield of Neufchâtel and cream cheese varies with the composition of the milk and the methods employed in making. One hundred pounds of milk containing 4 per cent fat yields from 14 to 16 pounds of Neufchâtel cheese, and milk containing from 6 to 8 per cent fat yields from 18 to 20 pounds of cream cheese. Higher yields sometimes are obtained, but cheese with a much higher yield is too soft to handle satisfactorily. Pasteurization ordinarily increases the yield from one-half to 1 pound per 100 pounds of milk. Usually when a lower yield is obtained the cheese is gummy and unattractive to the average buyer. If made from milk containing less butterfat correspondingly lower yields are obtained, as is the case when Neufchâtel cheese is made from partially skimmed milk, such as one-third, one-half, or even two-thirds skim.

EXPERIMENTAL WORK ON THE MANUFACTURING PROCESS.

Experiments were conducted to determine the most efficient methods to follow in the manufacture and subsequent handling of the Neufchâtel group of cheeses. The manufacturing phase of the work requires a consideration of the methods that will (1) reduce losses to a minimum, (2) insure a safe product, and (3) make the cheese most economically. The second phase of the work considers the

various factors which may influence the keeping qualities of the cheese. Very little previous work has been done along this line.

A study of each of the important steps has been found necessary to gather definite information with regard to the most efficient system of manufacturing, which includes a consideration of three factors: (1) Initial condition of curd; (2) rapidity of drainage; (3) fat losses. The following subjects have been considered:

1. Effect of different quantities of rennet.
2. The use of pepsin as a substitute for rennet.
3. Effect of temperature on the making process.
4. Effect of starter on the making process.
5. Effect of pasteurization and starters on the making process.
6. Effect of pasteurization on the moisture content of the cheese.
7. Effect of homogenization on the making process.

EFFECT OF DIFFERENT QUANTITIES OF RENNET.

A definite quantity of rennet is necessary in the manufacture of the Neufchâtel group of cheeses in order to obtain the characteristic curd, which must be neither too soft nor too brittle. The high cost of rennet requires that the curdling agent be used judiciously. So far nothing has been published regarding the most efficient and economical quantity of rennet to use for these cheeses. The quantity of rennet necessary depends not only upon the rate at which the whey is expelled, but also upon the breaking up of the curd and upon the fat losses caused thereby.

To determine this point, commercial liquid rennet in proportions varying from one-fourth of a cubic centimeter to 4 c. c. per 100 pounds of milk was used, with the results shown in Table 1. In each case 250 c. c. of lactic starter was added to each 30-pound unit of milk. Thirty pounds of milk was used in each of the experiments. All the whey was collected and measured from the time the coagulum was poured upon the draining cloths until the curd was in fit condition to ice, or in some cases for only part of that time. In any case the different parts of each sample were handled in the same manner. Fat determinations were made of each unit of a sample.

It is noticeable that the losses of fat increase with the higher percentages of fat in the milk, and there is also a slight increase in losses with the higher proportions of rennet. The losses of fat in the whey appear to be greatest when the large quantity of rennet causes the coagulum to be so brittle that it appears to break up more readily than when the lower proportion of rennet is used. Rennet in as small quantities as one-half of a cubic centimeter gave fairly satisfactory results with Neufchâtel cheese, though the curd of cream cheese appeared somewhat too moist. When 3 or 4 c. c. of rennet per

100 pounds was used, the curd was too dry to be satisfactory and the draining period was not shortened. There is a gradual increase in the whey expelled with the larger quantity of rennet until about 4 c. c. is used, when the drainage appears to be checked slightly.

Rennet used at the rate of from one-half to 2 c. c. per 100 pounds seems to be the most satisfactory for Neufchâtel cheese, whereas 1 c. c. to 2 c. c. seems most desirable for a like quantity of cream cheese.

TABLE 1.—*Effect of different quantities of rennet in the manufacture of Neufchâtel and cream cheese.*

Rennet per 100 pounds.	Neufchâtel.									Cream.					
	Sample 1. Set at 28° C. (82.4° F.). Fat, 3.6 per cent.			Sample 2. Set at 26° C. (78.8° F.). Fat, 3.1 per cent.			Sample 3. Set at 27° C. (80.6° F.). Fat, 4.33 per cent.			Sample 4. Set at 25° C. (77° F.). Fat, 6.3 per cent.			Sample 5. Set at 25° C. (77° F.). Fat, 7.2 per cent.		
	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.
	Per ct.	*Grams.*		*Per ct.*	*Grams.*		*Per ct.*	*Grams.*		*Per ct.*	*Grams.*		*Per ct.*	*Grams.*	
½ c. c.		2,550	Too moist												
½ c. c.		6,000	Good	0.15	8,600	Good				0.3	6,150	Too moist	0.45	5,170	Too moist.
¾ c. c.		7,400	Good	.15	8,300	Good		7,000	Good						
1 c. c.		6,700	Good	.15	7,920	Good	0.25	6,650	Good	.35	6,970	Good	.35	5,580	Good.
2 c. c.				.15	9,620	Good	.28	7,200	Good	.35	7,070	Good	.40	5,860	Good.
3 c. c.				.15	9,620	Too dry	.30	7,300	Too dry	.40	7,360	Too dry	.45	6,720	Too dry.
4 c. c.				.15	8,720	Too dry		7,000	Too dry	.40	7,590	Too dry			

PEPSIN AS A SUBSTITUTE FOR RENNET.

The scarcity of rennet has caused cheese manufacturers to look for a substitute. Table 2 shows the results of pepsin tests with cream cheese in quantities of one-sixth to one-twenty-fourth of a gram per 100 pounds of milk and fat determinations made of the whey.

TABLE 2.—*Effect of varying quantities of pepsin upon fat loss and condition of curd for cream cheese.*

Sample No.	Quantity of curdling agent per 100 pounds of milk.	Fat loss in whey.	Fat in milk.	Setting temperature.	Starter per unit of 30 pounds.	Criticism of curd.
		Per cent.	*Per cent.*			
1	Pepsin, 1/6 gram	0.18	5.8	27° C. (80.6° F.)	200 c. c.	Too dry.
	Pepsin, 1/8 gram	.14	5.8	do	do	Good.
	Pepsin, 1/12 gram	.14	5.8	do	do	Do.
	Pepsin, 1/16 gram	.15	5.8	do	do	Do.
	Pepsin, 1/24 gram	.14	5.8	do	do	Too moist.
	Rennet, 1 c. c.	.14	5.8	do	do	Good.
2	Pepsin, 1/6 gram	.08	5.9	29° C. (84.2° F.)	250 c. c.	Too dry.
	Pepsin, 1/8 gram	.10	5.9	do	do	Good.
	Pepsin, 1/12 gram	.08	5.9	do	do	Do.
	Pepsin, 1/24 gram	.10	5.9	do	do	Too moist.
	Rennet, 1 c. c.	.08	5.9	do	do	Good.

Pepsin used at the rate of about one-twelfth of a gram per 100 pounds gave the best results. With one-sixth of a gram for an equal quantity of milk the curd was too dry, while it was too moist when only one-twenty-fourth of a gram was used. The fat losses in the whey were practically the same for both the pepsin-made and the rennet-made cheese.

EFFECT OF TEMPERATURE ON THE MAKING PROCESS.

The literature about Neufchâtel and cream cheese shows different opinions relative to the temperature to use in their manufacture, the figures varying from 20° to 25° C. (68° to 77° F.). In our experiments to test this matter somewhat higher temperatures were found preferable. Temperatures ranging from 15° to 34½° C. (59° to 94.1° F.) were used. There was a degree or two of variation between the temperature of setting and that of pouring. The average temperature is given in the table. The method of making was the ordinary one previously described. The results are seen in Table 3.

It is noticeable that the losses of fat increase in the samples with the higher percentages of fat, and that the losses with the low-setting temperatures are somewhat high. A temperature below 25° C. (77° F.) or much above 30° C. (86° F.) did not prove desirable for the setting of either type of cheese.

TABLE 3.—*Effect of setting temperature upon loss of fat and the quantity of whey.*

Setting temperature.	Neufchâtel.									Cream.					
	Sample 1. Rennet, 1 c. c. per 100 pounds. Fat, 4 per cent.			Sample 2. Rennet, 1 c. c. per 100 pounds. Fat, 4.3 per cent.			Sample 3. Rennet, 1 c. c. per 100 pounds. Fat, 4 per cent.			Sample 4. Rennet, 1 c. c. per 100 pounds. Fat, 6.1 per cent.			Sample 5. Rennet, 1 c. c. per 100 pounds. Fat, 5.9 per cent.		
	Fat loss.	Whey per unit.[1]	Criticism of curd.	Fat loss.	Whey per unit.[1]	Criticism of curd.	Fat loss.	Whey per unit.[1]	Criticism of curd.	Fat loss.	Whey per unit.[1]	Criticism of curd.	Fat loss.	Whey per unit.[1]	Criticism of curd.
	Per ct.	*Grams.*		*Per ct.*	*Grams.*		*Per ct.*	*Grams.*		*Per ct.*	*Grams.*		*Per ct.*	*Grams.*	
15° C. (59° F.)	0.40	1,110	Too moist												
17½° C. (63.5° F.)				0.35	4,970	Too moist									
20° C. (68° F.)	.35	3,860	Too moist							0.40	7,560	Too moist			
20.5° C. (69° F.)													0.35	7,810	Moist.
21° C. (69.8° F.)							0.25	6,770	Little too moist.						
23.5° C. (74.3° F.)				.30	7,660	Moist									
25° C. (77° F.)							.20	8,250	Good	.35	7,200	Good			
25.5° C. (77.9° F.)	.20	6,320	Good										.35	8,320	Good.
26° C. (78.8° F.)				.25	8,010	Good									
28.5° C. (83.3° F.)							.20	9,030	Good						
29.5° C. (85.1° F.)										.35	8,560	Slightly dry.	.35	8,500	Slightly dry.
30° C. (86° F.)	.25	8,680	Good	.25	8,720	Good									
32° C. (89.6° F.)							.20	10,000	Too dry						
33.5° C. (92.3° F.)				.20	9,810	Too dry							.40	10,640	Too dry.
34° C. (93.2° F.)	.10	10,570	Too dry												
34.5° C. (94.1° F.)										.40	9,120	Too dry			

[1] Weight in grams was not carried to the last place.

EFFECT OF STARTER ON THE MAKING PROCESS.

Very little information is available as to how much starter may be safely added to ripen milk for making Neufchâtel cheese. When milk is pasteurized the need of carefully determining this point is obvious, for the desirable development of acidity must be assured or the cheese will be rendered unfit for sale. The effect of varying quantities of starter upon the fat loss in the whey is another point to be noted.

Samples of Neufchâtel and cream cheese were made without starter, while others contained from 1 to 1,250 c. c. of starter per 30-pound unit, as indicated in Table 4.

TABLE 4.—*Effect of starter on fat loss and drainage.*

Set at 25° C. (77° F.).

Sample 1 (Neufchâtel). Rennet 1½ c. c. Fat 3.1 per cent.				Sample 2 (cream). Rennet 1½ c. c. Fat 6.3 per cent.			
Quantity of starter.	Fat loss.	Whey per unit.	Criticism of curd.	Quantity of starter.	Fat loss.	Whey per unit.	Criticism of curd.
	Per cent.	*Grams.*			*Per cent.*	*Grams.*	
1 c. c.	0.15	8,150	Good.	None	0.6	9,170	Off flavor.
10 c. c.	.15	8,160	Good.	10 c. c.	.35	5,880	Good.
250 c. c.	.15	9,170	Good.	50 c. c.	.30	7,020	Good.
				250 c. c.	.30	7,430	Good.
				1,250 c. c.	.35	8,490	Good.

Set at 28½° C. (83.3° F.).

Sample 3 (Neufchâtel). Rennet ¾ c. c. Fat 3.8 per cent.				Sample 4 (cream). Rennet 1 c. c. Fat 5.6 per cent.			
Quantity of starter.	Fat loss.	Whey per unit.	Criticism of curd.	Quantity of starter.	Fat loss.	Whey per unit.	Criticism of curd.
	Per cent.	*Grams.*			*Per cent.*	*Grams.*	
None	0.6	9,060	Gassy.	None	1.1	10,180	Gassy.
10 c. c.	.06	8,150	Good.	10 c. c.	.10	7,810	Good.
50 c. c.	.06	8,620	Good.	50 c. c.	.10	9,060	Good.
250 c. c.	.07	8,830	Good.	250 c. c.	.10	8,150	Good.
1,250 c. c.	.19	8,380	Fair.	1,250 c. c.	.10	7,110	Fair.

The loss of fat shows the desirability of using starter instead of depending upon the normal fermentation, which may be gassy. Gassy fermentations are especially liable to occur in the spring months. Such fermentations may be sufficiently vigorous to cause the curd to run over the sides of the setting cans and often greatly reduce the yield of cheese, as well as lowering its quality.

Little difference was noted in the cheese made with varying quantities of starter. The use of heavy starter, as in case of samples 3 and 4, had a tendency to check drainage rather than encourage it. The same effect is caused by milk that has been ripened to a high degree before setting. As indicated in Table 4, there seems to be an advantage in setting the milk at 28½° C. (83.3° F.) and using rennet at the rate of 1 c. c. per 100 pounds rather than setting the milk at 25° C. (77° F.) and using 1½ c. c. of rennet for an equal quantity. There was very little difference in the flavor of the cheese made with different quantities of starter up to 250 c. c. per unit of 30 pounds.

EFFECT OF PASTEURIZATION.

The primary object in the pasteurization of milk for Neufchâtel and cream cheese is to render the resulting cheese safe from disease-producing organisms, and as a secondary object to reduce losses to a minimum. In addition, with the use of vigorous starter there should be little danger of a gassy fermentation after pasteurization. Several trials were made with pasteurized and nonpasteurized cheese to study their effects upon fat loss and drainage, as indicated in Table 5.

TABLE 5.—*Effect of pasteurization on fat losses and rate of drainage.*

Pasteurization temperature.	Neufchâtel.					
	Sample 1. Rennet ½ c. c. set at 25° C. (77° F.). Fat, 3.2 per cent.			Sample 2. Rennet ½ c. c. set 25° C. (77° F.). Fat, 4 per cent.		
	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.
	Per cent.	*Grams.*		*Per cent.*	*Grams.*	
Not pasteurized	0.2	7,360	Good.	0.2	7,420	Good.
60° C. (140° F.)	.25	6,730	Good.	.2	6,720	Good.
65° C. (149° F.)	.25	6,900	Good.	.2	7,180	Good.
70° C. (158° F.)	.25	7,130	Good.	.2	6,830	Good.

Pasteurization temperature.	Cream.								
	Sample 3. Rennet ½ c. c. Set 25° C (77° F.). Fat 5.9 per cent.			Sample 4. Rennet ½ c. c. Set 25° C. (77° F.). Fat 6.3 per cent.			Sample 5. Rennet ½ c. c. Set 25° C. (77° F.). Fat 5.8 per cent.		
	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.	Fat loss.	Whey per unit.	Criticism of curd.
	P. ct.	*Grams.*		*P. ct.*	*Grams.*		*P. ct.*	*Grams.*	
Not pasteurized	0.25	9,490	Good.	0.3	7,380	Good.	0.25	6,430	Good.
60° C. (140° F.)	.30	7,130	Good.	.3	5,940	Good.	.30	5,390	Good.
65° C. (149° F.)	.30	7,700	Good.	.3	6,000	Good.	.35	5,660	Good.
70° C. (158° F.)	.30	7,300	Good.	.35	6,680	Good.	.35	5,660	Good.

Comparatively little difference was found in the losses either with or without pasteurization, or with the different temperatures for pasteurization. These figures show that where milk is pasteurized for making Neufchâtel cheese the resulting curd tends to retain more of the whey. While theoretically the fat losses should be reduced somewhat by pasteurization because of the slowness with which the cream rises to the surface of the milk, yet the results fail to indicate any marked difference.

EFFECT OF PASTEURIZATION ON THE MOISTURE CONTENT OF THE CHEESE.

Pasteurization tends to give a higher percentage of water in Neufchâtel cheese than is the case in that made from raw milk. It appears that the pasteurized curd is more retentive, possibly because the curd particles are more finely divided than those from raw milk. When the pasteurized and the raw product are handled under the same conditions as far as we are able to control them, there is about 2½ per cent greater yield in moisture with the pasteurized cheese. Table 6 illustrates this point.

TABLE 6.—*Water in pasteurized and unpasteurized cream cheese.*

Sample No.	Not pasteurized.	Pasteurized.
	Per cent. moisture.	*Per cent. moisture.*
1	46.18	51.26
2	48.82	50.06
3	46.00	46.06
Average	47.00	49.46

These figures are from chemical analysis by Dr. J. N. Currie, formerly of the Dairy Division.

EFFECT OF HOMOGENIZATION ON THE MAKING PROCESS.

The cheese made from homogenized milk seems to "handle" very well, and the whey from the curd was remarkably clear. While it is possible that not all the fat is measured by the ordinary Babcock test, yet it is believed that such determinations give at least a very close approximation to the fat loss.

With cream cheese the fat losses are liable to be excessive. With the object of reducing these losses, milk was first standardized and then homogenized at a temperature of 43° C. (109.4° F.) and 2,000 pounds pressure. The homogenized and unhomogenized samples of the same percentage of fat were taken from the same lots of milk. Cream cheese was then made in the usual way and the fat losses determined.

TABLE 7.—*Effect of homogenization on fat losses in cream cheese.*

Sample No.	Loss of fat.	Fat in milk.	Temperature of setting.	Quantity of starter per unit.	Rennet added per 100 pounds.	Criticism of curd.
	Per ct.	*Per ct.*		*C. c.*	*C. c.*	
1. Homogenized	0.015	6.2	30° C. (86° F.)	250	1	Good curd, whey very clear.
2. Homogenized	.020	6.2	do	250	1	Do.
3. Homogenized	.020	6.2	do	250	1	Do.
4. Homogenized	.025	6.2	do	250	1	Do.
5. Homogenized	.015	6.2	do	250	1	Do.
6. Not homogenized	.200	6.2	do	250	1	Good curd.
7. Homogenized	.04	6.0	do	250	1	Good curd, whey very clear.
8. Not homogenized	.150	6.0	do	250	1	Good curd.

There is a slight advantage in homogenization in reducing the fat losses, but it is doubtful whether there is sufficient gain by this process to justify the added cost of such treatment.

EXPERIMENTAL WORK ON KEEPING QUALITIES OF THE CHEESE.

Neufchâtel and similar cheeses are very perishable products, the length of time that they can be kept depending upon the manner in which the cheese has been handled and the nature and quantity of the added ingredients. In the study of this problem the following points were considered:

1. Influence of yield on quality.
2. Influence of salt on keeping quality.
3. Influence of the holding system of pasteurization.
4. Effect of homogenization and of the flash and holding systems of pasteurization on keeping quality.
5. The use of powdered pepsin.
6. Influence of pimiento peppers.

INFLUENCE OF YIELD ON QUALITY.

In order to study the influence of yield upon quality, cream cheese was made in the customary manner, with the exception that some samples were pressed more than others. The samples were made to give yields varying from 15 to 24 pounds per 100 pounds of milk, and some were pasteurized, while others were not. The samples were kept at 10° C. (50° F.) and 20° C. (68° F.) and were judged by a number of persons at various intervals, with the results shown in Table 8.

In this and succeeding tests (Tables 9 to 13) the number of persons judging the cheese varied from time to time. This was unavoidable, as it was not practicable to have the same number each time.

TABLE 8.—*The effect of yield upon keeping quality of cream cheese in storage.*

[Samples held at 10° C. (50° F.).]

Sample 1.					Sample 2.						Sample 3.				
	Yield from 100 pounds of milk.					Yield from 100 pounds of milk, not pasteurized.						Yield from 100 pounds of milk.			
Age of cheese.	21 pounds, pasteurized.	18 pounds, pasteurized.	15 pounds, pasteurized.	18 pounds, not pasteurized.	Age of cheese.	24 pounds.	21 pounds.	18 pounds.	15 pounds.	No preference.	Age of cheese.	21 pounds, pasteurized.	18 pounds, pasteurized.	15 pounds, pasteurized.	18 pounds, not teurized.
Days.					*Days.*						*Days.*				
4	[1] 2	3	1	1	2	1	1	1	1	1	4	1	3	1	2
8	2	3	2	1	4	0	0	2	0	1	6	2	2	2	2
11	1	2	2	1	6	0	2	0	0	0	8	2	3	1	1
15	1	3	2	2	7	0	3	1	1	.....	11	1	2	2	1
18	2	2	1	2	8	0	1	1	0	0	13	1	2	1	1
21	3	3	2	1	11	0	0	3	0	1	15	2	2	2	2
25	2	2	2	1	16	1	0	1	0	0	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	18	2	3	2	1	1	.....	.....	.....	.....	.....

[1] The figures 1, 2, and 3 in body of table indicate the number of people expressing a preference for particular samples of cheese. In this and subsequent tests it was impracticable to have the same number of judges for each set of samples.

The samples that yielded highest appeared slightly more acid than the low-yield cheese, although the differences were not especially marked. The low-yield cheese seemed much more "gummy" and more quickly developed a Cheddarlike flavor after being kept several days. The majority of the judges preferred the cheese giving a yield of 18 pounds per 100 pounds of milk, while nearly as many preferred the cheese giving a yield of 21 pounds. With a yield of much more than 20 pounds per 100 pounds of milk, much difficulty will be experienced in running the curd through the molding machine. Because of that fact there is little danger of manufacturers making too moist a cheese.

INFLUENCE OF SALT ON KEEPING QUALITY.

In order to study the influence of salt in cheese upon its keeping quality, cream cheese was made in the usual way from milk testing 6.2 per cent fat, and portions were salted at the rate of $\frac{1}{4}$, $\frac{3}{4}$, $1\frac{1}{4}$, and $1\frac{1}{2}$ per cent. The cheese was wrapped in tin foil and held at 10° C. (50° F.) and 22° C. (71.6° F.) and examined at various periods. Table 9 gives the result of the experiment.

TABLE 9.—*Influence of salt on keeping quality of cream cheese.*

Age of cheese.	Held at 10° C. (50° F.)				Held at 22° C. (71.6° F.)			
	Per cent of salt.				Per cent of salt.			
	¼	¾	1¼	1½	¼	¾	1¼	1½
Days.								
3	[1] 0	5	3	3	0	3	[illegible]	[illegible]
6	0	3	3	1	0	2	3	2
8	0	1	4	0	0	0	5	0
11	0	2	3	1	0	1	4	0
15	0	1	2	0				
19	0	1	1	0				
24	0	1	2	0				
28	0	0	1	0				

[1] The figures in body of table indicate the number of people expressing a preference for a particular kind of cheese.

Most people seem to prefer a cheese containing from three-fourths to 1½ per cent of salt. The cheese with one-fourth per cent salt was pronounced flat and insipid, while that with 1½ per cent was usually considered too salty. The cheese with the one-fourth per cent salt spoiled more quickly than the other samples. When a few days old a slight bitterness developed in the cheese containing 1½ per cent salt, while there was a distinct "off flavor" in the low-salted cheese. The cheese containing three-fourths and 1¼ per cent of salt seemed to keep equally well. In general the lower proportion of salt, about three-fourths to 1 per cent, is to be preferred, because a higher per cent has a tendency to hide the finer flavors of the cheese.

INFLUENCE OF THE HOLDING SYSTEM OF PASTEURIZATION.

To test the keeping qualities of pasteurized and unpasteurized cream cheeses, some experimental cheese was made at a commercial factory and sent to the laboratory of the Dairy Division. The cheese was shipped by express and upon arrival was placed in rooms maintained by an electric control at 20°, 15°, 10°, and 5° C. (68°, 59°, 50°, and 41° F.), respectively.

The initial heating of the milk was accomplished by running it through a pasteurizer where a temperature of about 62° C. (143.6° F.) was maintained for 35 minutes or longer. The milk was then run over cooling coils and cooled to the proper temperature for setting. One and one-half per cent of a vigorous starter was then added and the milk thoroughly stirred, after which the making process was carried on in the usual manner. The cheese was made from milk testing approximately 6 per cent fat. Samples were collected on successive days from the 200 or 300 pounds of experimental cheese.

The keeping qualities of the pasteurized and unpasteurized cheese held at various temperatures were determined by submitting samples of both, marked only by numbers, to individuals who recorded their preferences, as shown in Table 10.

TABLE 10.—*Keeping qualities of pasteurized and unpasteurized cream cheese in storage.*

Sample No.	Age of cheese.	Held at 20° C. (68° F.). Pasteurized.	Not pasteurized.	No preference.	Held at 15° C. (59° F.). Pasteurized.	Not pasteurized.	No preference.	Held at 10° C. (50° F.). Pasteurized.	Not pasteurized.	No preference.	Held at 5° C. (41° F.). Pasteurized.	Not pasteurized.	No preference.
	Days.												
1	5	[1] 8	4	1	6	6	1	9	4	0	9	4	0
	8	8	3	1	10	2	0	.....	.....	.....	.....	.....	.....
	9	7	1	0	7	1	0	7	1	0	6	1	1
	12	4	1	2	4	1	2	6	1	0	6	1	0
	14	3	3	2	5	2	1	4	3	1	5	3	0
	16	3	6	0	5	3	1	2	6	1	7	2	0
2	5	6	2	0	5	2	1	5	2	1	5	2	1
	7	6	3	2	6	3	2	.....	.....	.....	.....	.....	.....
	10	6	4	2	7	3	2	6	4	2	6	4	2
	12	0	2	1	1	1	1	.....	.....	.....	.....	.....	.....
	14	0	3	2	4	1	0	2	2	1	3	2	0
3	4	4	2	1	4	1	2	3	1	3	4	1	2
	6	5	2	5	7	2	3	.....	.....	.....	.....	.....	.....
	8	2	2	4	2	2	4	5	3	0	4	2	2
	10	5	2	2	8	0	1	.....	.....	.....	.....	.....	.....
	12	1	5	3	1	3	5	2	3	4	4	4	1

[1] The figures in body of table indicate the number of persons expressing a preference for a certain kind of cheese.

The results seem to indicate that for about the first 10 days the preference was in favor of the pasteurized product for all temperatures. From 10 to 15 days the preference was for the pasteurized cheese held at 15° C. (59° F.) and 5° C. (41° F.) and for the unpasteurized cheese at 10° C. (50° F.) and 20° C. (68° F.).

In nearly every case the texture of the pasteurized product was judged superior to the unpasteurized. The difference may be partially accounted for by a small increase in water occasioned by the pasteurization.

EFFECT OF HOMOGENIZATION AND OF THE FLASH AND HOLDING SYSTEMS OF PASTEURIZATION ON KEEPING QUALITY.

To determine the most desirable system of handling milk prior to manufacturing it into cream cheese, so far as the keeping quality of the cheese is concerned, the following methods were studied:

1. Homogenization of the milk.
2. Flash system of pasteurization.
3. Holding system of pasteurization.
4. Check (where milk for cheese was neither homogenized nor pasteurized).

The samples of cheese compared were made from milk coming from the same vat, having therefore the same percentage of fat. When homogenization was practiced the milk was sent through the machine at 43° C. (109.4° F.) and with 2,000 pounds' pressure. Pasteurization by the flash system was carried on at 76.6° C. (170° F.).

In the holding system of pasteurization two temperatures were used, 62.8° C. (145° F.) and 76.6° C. (170° F.). The milk was heated to these temperatures, held for 30 minutes, and then cooled to the setting temperature.

The milk was manufactured into cheese in the customary manner and the samples judged at intervals, as indicated in Table 11.

TABLE 11.—*Effect of homogenization and the flash and holding systems of pasteurization upon cream cheese in storage.*

Sample 1, held at—							Sample 2, held at—						Sample 3, held at—					
	10° C. (50° F.).		15° C. (59° F.).		20° C. (68° F.).			10° C. (50° F.).						10° C. (50° F.).				
Age of cheese.	Not pasteurized.	Homogenized.	Not pasteurized.	Homogenized.	Not pasteurized.	Homogenized.	Age of cheese.	Homogenized.	Flash pasteurized at 76.6° C. (170° F.).	Hold pasteurized at 76.6° C. (170° F.).	Hold pasteurized at 62.8° C. (145° F.).	Not pasteurized.	Age of cheese.	Homogenized.	Flash pasteurized at 76.6° C. (170° F.).	Hold pasteurized at 76.6° C. (170° F.).	Hold pasteurized at 62.8° C. (145° F.).	Not pasteurized.
Ds.							*Days.*						*Days.*					
3	[1]7	0	7	0	7	0	3	1	2	3	2	1	3	2	1	2	2	0
5	7	0	7	0	7	0	4	1	1	3	2	1	5	1	2	2	2	0
7	3	0	3	0	3	0	6	1	1	3	2	1	8	1	1	2	2	1
10	4	0	4	0	4	0	7	0	1	2	1	1	11	1	1	2	2	1
13	3	0	3	0	0	0	8	0	0	1	1	0	.....	.....	.....	.....	.....	.....
17	4	0	4	0	0	0	9	0	0	1	1	0	.....	.....	.....	.....	.....	.....
21	2	0	2	0	0	0	10	0	0	1	1	1	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	12	0	0	1	1	0	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	15	0	0	1	1	0	.....	.....	.....	.....	.....	.....

[1] The figures in body of table indicate the number of persons expressing a preference for a particular sample of cheese.

It may be noted that with the cheese from homogenized milk results were not the same for samples 1, 2, and 3. In sample 1 there was a peculiarly bitter, rancid flavor, which in most cases could be detected also in samples 2 and 3, but was much less in evidence. At other times Neufchâtel cheese made from homogenized milk testing about 4 per cent fat had such an extremely rancid flavor as to render it unfit for market purposes. It appears, therefore, that there is greater danger of developing this characteristic homogenized flavor with milk of low fat than with milk of high fat content.

The process of homogenization seems to be responsible for the bitter flavor observed in the cheese, for this bitter flavor is readily observed in the fresh cheese and does not develop further in storage.

The only justification for the use of homogenization is to reduce the fat loss to a minimum. The process, however, is practically unnecessary, because under normal conditions the fat losses may be reduced nearly as much in other ways and there is far less danger of developing a bitter flavor in the cheese.

There is very little difference apparently in the keeping qualities of cream cheese made from milk pasteurized by the flash system as compared with the holding system.

THE USE OF POWDERED PEPSIN.

Owing to the reduction of imports from Europe, rennet has risen to a very high price. Pepsin has been recommended as a substitute for rennet in the making of American cheese, but not for Swiss, Limburger, and other sweet-milk cheese. Experiments have been carried out with the different forms of pepsin in the manufacturing of cream cheese. The cheese was handled in the usual way and then placed at different temperatures, as indicated in Table 12.

TABLE 12.—*Comparison of use of rennet with powdered pepsin in manufacture of cream cheese held in storage.*

Sample 1. Held at 10° C. (50° F.).					Sample 2. Held at 20° C. (68° F.).					Sample 3. Held at 10° C. (50° F.).			Sample 4. Held at 20° C. (68° F.).			Sample 5. Held at 10° C. (50° F.).		
	Unpasteurized.		Pasteurized.			Unpasteurized.		Pasteurized.			Unpasteurized.			Unpasteurized.			Unpasteurized.	
Age of cheese.	Rennet.	Powdered pepsin.	Rennet.	Powdered pepsin.	Age of cheese.	Rennet.	Powdered pepsin.	Rennet.	Powdered pepsin.	Age of cheese.	Rennet.	Powdered pepsin.	Age of cheese.	Rennet.	Powdered pepsin.	Age of cheese.	Rennet.	Powdered pepsin.
Days					*Days.*					*Days.*			*Days*			*Days*		
4	[1] 4	3	4	3	4	3	4	4	3	3	4	3	3	3	4	4	6	
6	5	2	3	4	6	3	2	2	3	12	3	3	5	3	3	7	2	3
8	2	1	1	2	8	2	1	2	1	14	2	1	7	2	1	11	3	4
11	2	2	2	2	11	1	3	2	2	17	2	2	10	2	2	13	3	3
14	1	2	1	2	------	-----	-----	-----	-----	20	1	1	13	2	1	17	3	2
18	2	2	3	1	------	-----	-----	-----	-----	24	2	2	-----	-----	-----	21	1	2
22	1	1	1	1	------	-----	-----	-----	-----	27	2	1	-----	-----	-----	-----	-----	-----

[1] The figures in body of table indicate the number of persons expressing a preference for a particular sample of cheese.

The results indicate that there is practically no difference in keeping qualities between cheese made from the powdered and that made from scale pepsin, or a difference so slight as to be negligible.

INFLUENCE OF PIMIENTO PEPPERS.

In order to study the influence of pimiento peppers upon the keeping qualities of pimiento-cream cheese, samples were made from milk testing 6 per cent fat and salted at the rate of 1 pound of salt to 100 pounds of curd. Varying quantities of the peppers were added to the cheese, which was placed in glass jars and capped, and samples kept at 5°, 10°, 15°, and 20° C. (41°, 50°, 59°, and 68° F.), respectively. Other samples were made at the same time without the peppers and placed at similar temperatures for comparison. The samples of cream and pimiento cheese were made from the same lot of milk where their keeping qualities are compared at a given temperature. Table 13 gives the result of the trials.

TABLE 13.—*Influence of pimiento peppers on the keeping qualities of cream cheese in storage.*

Sample No.	Age of cheese.	Held at 5° C. (41° F.).				Held at 15° C. (59° F.).			
		Pimiento 1/10.	Pimiento 1/20.	Pimiento 1/40.	Cream cheese.	Pimiento 1/10.	Pimiento 1/20.	Pimiento 1/40.	Cream cheese.
	Days.								
1	4	[1] 4	2	2	0	3	3	2	0
	6	9	8	0	0	9	8	0	0
	8	5	3	0	0	3	5	0	0
	13	5	2	2	0	4	3	2	0
	18	3	2	1	0	.....	.....	.....	.....
	28	3	0	1	0	.....	.....	.....	.....
	43	2	0	1	0	.....	.....	.....	.....
		Held at 10° C. (50° F.).				Held at 20° C. (68° F.).			
2	10	6	.....	.....	0	5	.....	.....	1
	17	3	.....	.....	0	2	.....	.....	1
	21	4	.....	.....	0	.....	.....	.....	.....
	27	3	.....	.....	0	.....	.....	.....	.....
	35	4	.....	.....	0	.....	.....	.....	.....

[1] The figures in body of table indicate number of people showing preference for particular samples.

A high percentage of pimientos seems to improve the keeping quality of the cheese kept at 5° C. (41° F.) and 10° C. (50° F.). When held at 10° C. (50° F.) the pimiento cheese kept in good condition for a month, at which time it was edible, although some acidity had developed. No undesirable flavor had developed as in the case of the plain cream cheese. Either the pimiento acts as a preservative or it tends to cover up any undesirable flavor. When kept at 15° C. (59° F.) and especially at 20° C. (68° F.) both the cream and the pimiento cheese became excessively sour in the course of a few days. There was a marked difference in this sour taste in the cheese held at 15° C. (59° F.) and 10° C. (50° F.). Pimiento-cheese held at 5° C. (41° F.) was still edible after six weeks, although some of the surface of the cheese had to be removed.

SUMMARY.

The process of manufacture for Neufchâtel and cream cheese is the same, except as noted. For Neufchâtel use whole milk that tests about 4 per cent; for cream cheese use milk standardized to from 6 to 8 per cent butterfat. Obtain clean, fresh milk.

Pasteurize the milk by heating to 145° F. for 30 minutes and then quickly cool to 80° F. for Neufchâtel and 83° F. for cream cheese.

Add 1 per cent of a freshly made and vigorous lactic-acid starter.

Add either commercial liquid rennet at the rate of one-third of an ounce or five-sixths of a gram of powdered pepsin to each 1,000 pounds of milk for Neufchâtel cheese. For cream cheese use half an ounce of liquid rennet or 1 gram of powdered pepsin for each 1,000 pounds of milk. Either curdling agent should be diluted in half a pail of cold water before being mixed with the milk.

Stir the mixture of milk, starter, and curdling agent and then run it into shotgun cans, 30 pounds in each can, and set away to curdle.

In from 16 to 18 hours pour the contents of each can on cotton sheeting and allow to drain undisturbed for from 2½ to 3 hours. Then work the curd to the center of the cloth, loosen the ends, and make each unit into a bag by folding over the cloth. Place the bags of curd between alternate layers of cracked ice for a few hours or overnight.

Press the curd until each unit (bag) weighs 4½ pounds for Neufchâtel, or 5½ to 6 pounds for cream cheese. This means a yield for Neufchâtel of 15 pounds and for cream cheese of 18 to 20 pounds per 100 pounds of milk, which seems most desirable.

Remove the cakes of curd from the drain cloths and salt at the rate of 1 pound to 100 pounds of curd. Run the curd through a grinding machine, or use a mixing machine and incorporate the salt uniformly.

Pass the curd through a molding machine which shapes the cheese into the desired commercial package. Wrap in tin or aluminum foil and place in special flat boxes.

The homogenization of milk for making cream cheese is not recommended.

The addition of pimiento peppers at the rate of 1 part of peppers to 10 or 20 parts of cream cheese greatly prolongs the keeping quality of the cheese.

Keep the cheese at a temperature of between 40° and 50° F. until consumed.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 670

Contribution from Office of Public Roads and Rural Engineering,
LOGAN WALLER PAGE, Director.

Washington, D. C. PROFESSIONAL PAPER June 14, 1918

THE RESULTS OF PHYSICAL TESTS OF ROAD-BUILDING ROCK IN 1916 AND 1917.

By Prévost Hubbard, *Chemical Engineer*, and Frank H. Jackson, Jr., *Assistant Testing Engineer*.

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This bulletin supersedes United States Department of Agriculture Bulletin 537 and supplements Bulletin 370, which gives the results of the more common physical tests of some 3,650 road-building rock samples, examined prior to January 1, 1916. Tests of 655 additional samples examined in 1916 and 1917 are recorded in Table I, the rocks being classified as to their location. It will be noted that in a number of cases, in addition to other tests, the crushing strength of the rock also is given. This test is not made ordinarily when examining rock to determine its suitability for use in the various types of broken-stone roads, but is employed often when considering a rock for use in the manufacture of paving block or as railroad ballast. Table II gives a complete record of all of the crushing strength tests made by the office prior to January 1, 1916. A brief description of this test as made by the office follows.

CRUSHING STRENGTH OR COMPRESSION TEST.

This test is made upon a cylindrical test specimen 2 inches in diameter and 2 inches high. Both ends of the specimen, which have been sawed at right angles to the axis of the cylinder, and properly faced, are bedded in plaster of Paris. The cylinder then is crushed in a 200,000-pound universal testing machine. A small 2-inch spherical bearing block is placed between the moving head of the machine and the upper surface of the specimen. The average of at least two determinations is reported as the crushing strength, calculated in pounds per square inch. Crushing strength tests are made upon samples of road-building rock only when specifically requested.

The percentage variation in strength of 153 granites and gneisses and 156 limestones and dolomites, the total number of these types of rock tested up to January 1, 1918, is shown graphically in Figure 1. In this chart the percentage of total samples tested having various values for crushing strength are plotted as indicated. As an example, the chart shows that 7 per cent of all granites and gneisses tested have a crushing strength of 21,000 pounds per square inch. The sum of all per cents to the left of the 21,000-pound line totals 50; that is, 50 per cent of all granites and gneisses tested have a crushing strength of less than 21,000 pounds. On the other hand, 7 per cent of all the granites and gneisses show a crushing strength of 20,000 pounds per square inch, and by summing up all the per cents to the right of the 20,000-pound line, it will be seen that 50 per cent of the samples tested have a crushing strength greater than 20,000 pounds per square inch. In other words, the average crushing strength of this type of material lies between 20,000 and 21,000 pounds per square inch. By a similar interpretation, the average crushing strength of limestones and dolomites lies between 18,000 and 19,000 pounds per square inch. Further study of the chart shows that the crushing strength of limestones and dolomites closely approaches that of granites and gneisses.

INTERPRETATION OF RESULTS OF PHYSICAL TESTS.

To interpret the results of the physical tests made of road-building rock, the office has adopted a table of general limiting test values for broken stone for the various types of road construction which is printed on the back of the form for reporting tests. For general reference, these limiting values, together with comments upon limits shown, are given in Table IV. By comparing the results of tests on a sample of rock with the limits shown in the table, a general idea of the types of road construction for which it is best suited may be obtained. Table III contains the total number of rock samples received from the various States which have been tested up to January 1, 1918.

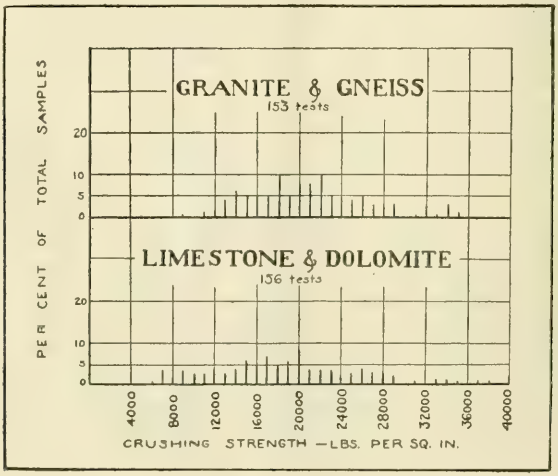

FIG. 1.—Variations in the crushing strength of rock.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918.*

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
			ALABAMA.								
10138	Bridgeport	Jackson	Oolitic limestone	(1)	168	0.21	4.4	9.1	15.7	5	41
9985	Birmingham	Jefferson	Limestone	(1)	168	.55	5.0	8.0	15.3	6	40
11506	Gantts Quarry	Talladega	Marble	(1)	169	.29	5.98	6	9.7	4	(1)
			ARIZONA.								
11642-A	Tucson (west of)	Pima	Siliceous limestone	(1)	166	0.48	5.4	7.4	15.5	5	13
			ARKANSAS.								
12461	Conway	Faulkner	Ferruginous sandstone	(1)	159	0.18	2.6	15.4	17.3	25	(1)
9828	Lamar	Johnson	Feldspathic sandstone	21,980	159	1.98	(1)	(1)	18.7	13	17
12320		Pulaski	do	(1)	162	.96	2.5	16.0	18.9	32	15
11511	Pfeiffer	Independence	Marble	(1)	163	1.06	(1)	(1)	14.0	5	(1)
9838	Fort Smith	Sebastian	Sandstone	(1)	150	5.00	6.5	6.2	15.3	6	25
10486	Gillham	Sevier	Feldspathic quartzite	(1)	164	.42	2.3	17.4	19.0	32	(1)
			CALIFORNIA.								
11373	San Jose	Santa Clara	Feldspathic quartzite	(1)	172	0.32	1.8	22.2	18.7	18	45
11527	San Francisco	San Francisco	Marble	(1)	176	.35	(1)	(1)	12.0	6	(1)
			COLORADO.								
9821	Lyons (near)	Boulder	Argillaceous limestone	(1)	162	2.98	4.9	8.2	15.3	7	162
9822	Lyons	do	Sandstone	(1)	156	1.73	3.4	11.8	18.3	11	36
9823	Lyons (near)	do	do	(1)	156	1.37	2.9	13.8	16.0	14	13
11168	Denver (near)	Jefferson	Augite andesite	(1)	169	1.27	2.7	14.8	15.3	17	98
11169	do	Denver	Smelter slag	(1)	216	.65	7.6	5.3	(1)	(1)	6
11170	do	do	do	(1)	217	.50	5.1	7.8	(1)	(1)	7
11171	do	do	do	(1)	217	.86	4.6	8.7	17.3	15	4

[1] Test not made.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

CONNECTICUT.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
9944	Plainville	Hartford	Diabase	(1)	184	1.14	2.0	20.0	19.0	23	102
11151	East Haven	New Haven	Altered basalt	(1)	169	.63	3.7	10.8	17.3	10	72
12114-A	Rocky Hill	Hartford	do	33,220	192	.34	2.7	11.8	17.3	21	49
12115-B	North Branford	New Haven	Diabase	(1)	184	.27	4.1	9.8	16.0	12	55
12235	Reed's Gap	do	do	10,817	182	.49	2.8	14.3	17.3	11	173
12018	North Branford	do	do	(1)	185	.91	3.8	10.6	15.3	10	(1)
11067	Waterford	New London	Granite	21,840	162	1.74	(1)	(1)	18.7	13	(1)
11068	do	do	Biotite granite	23,850	162	.78	(1)	(1)	18.7	8	(1)
11069	do	do	do	22,170	164	.71	(1)	(1)	18.7	14	(1)
9791	Oneco	Windham	do	16,635	(1)	(1)	(1)	(1)	18.3	8	(1)
11098	do	do	do	23,290	164	.55	(1)	(1)	18.7	6	(1)
11099	do	do	Gneissoid granite	20,200	163	.67	(1)	(1)	18.7	6	(1)
11148	(2)	do	do	20,825	163	.44	4.6	8.7	18.7	7	(1)

DELAWARE.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
11722	Wilmington	New Castle	Feldspathic quartzite	21,060	(1)	(1)	(1)	(1)	18.7	10	(1)

FLORIDA.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
10192	Titusville	Brevard	Shell limestone	(1)	155	4.03	7.5	5.3	14.9	2	42
10776	(2)	Broward	Siliceous limestone	(1)	(1)	(1)	(1)	(1)	17.3	6	61
10411	Delray (3 miles west)	Palm Beach	Shell limestone	(1)	(1)	(1)	50.9	0.8	(1)	(1)	52
10430	Boynton (near)	do	do	(1)	(1)	(1)	37.2	1.1	(1)	(1)	40
10431	Jupiter (15 miles west)	do	Siliceous limestone	(1)	(1)	(1)	12.5	3.2	14.7	5	43

GEORGIA.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
10398	Cartersville (3 miles east).	Bartow	Quartz schist	(1)	159	0.71	5.0	8.0	19.3	11	(1)
10399	Cartersville	do	Ferrugineous-sandstone	(1)	145	8.74	22.0	1.8	(1)	(1)	(1)
10400	Cass Station (2 miles north).	do	Sandstone	(1)	152	2.86	(1)	(1)	18.7	12	(1)

10645	Carrollton (4 miles north).	Carroll	Biotite gneiss	(1)	172	.35	4.7	8.5	17.7	7	(1)	
10646	Carrollton	do	Granite gneiss	(1)	165	.62	4.5	8.9	18.7	5	(1)	
10647	Carrollton (2 miles southwest).	do	do	(1)	169	.51	4.6	8.7	18.5	6	(1)	
10648	Carrollton	do	do	(1)	168	.53	4.8	8.3	18.7	4	(1)	
10654	Carrollton (7 miles northeast).	do	Biotite gneiss	(1)	166	.67	(1)	(1)	18.0	10	(1)	
10655	Temple (4 miles east)	do	do	(1)	169	.56	7.7	5.2	17.0	5	(1)	
10649	Carrollton (4 miles southeast).	do	Biotite schist	(1)	168	.51	5.7	7.0	18.9	8	(1)	
10651	Mabry	do	Epidote hornblendeschist	(1)	192	1.12	5.5	7.3	17.7	9	(1)	
10653	Roopville	do	Mica schist	(1)	168	.75	(1)	(1)	16.7	5	(1)	
10657	Bowden (1 mile north)	do	Amphibolite	(1)	187	1.20	19.0	2.1	10.5	4		27
11512	Ball Ground	Cherokee	Marble	(1)	169	.29	12.42	3.22	8.0	3	(1)	
11529	Holly Springs	do	Serpentine marble	21,850	178	.40	(1)	(1)	12.6	6	(1)	
10417	Athens	Clark	Biotite granite	(1)	165	.68	6.4	6.3	18.7	6	(1)	
10422	Athens (4 miles west)	do	do	(1)	163	1.56	(1)	(1)	15.4	4	(1)	
10423	Athens (4 miles from)	do	do	(1)	163	.58	4.4	9.1	17.8	9	(1)	
10420	Athens	do	do	(1)	167	.47	5.9	6.8	18.7	4	(1)	
10418	do	do	Granite gneiss	(1)	169	.76	7.5	5.3	17.7	6	(1)	
10421	Athens (south of)	do	Biotite gneiss	(1)	167	.65	(1)	(1)	18.7	6	(1)	
10377	Marietta (1½ miles south).	Cobb	do	(1)	170	.67	6.5	6.2	17.3	6	(1)	
10378	Chattahoochee River	do	do	(1)	165	.26	5.1	7.8	18.6	8	(1)	
10380	Lost Mountain Store	do	Hornblende gneiss	(1)	188	.93	(1)	(1)	13.3	4	(1)	
10381	Southeast Kennesaw Mountain.	do	Feldspathic gneiss	18,500	167	.73	(1)	(1)	18.7	6	(1)	
10382	Marietta (4 miles northwest).	do	Biotite gneiss	14,000	169	.50	5.6	7.1	17.3	6	(1)	
10387	Acworth (½ mile south).	do	do	(1)	175	.68	8.6	4.7	16.7	5	(1)	
10388	Acworth (4 miles south).	do	do	(1)	174	.59	10.1	3.9	16.7	5	(1)	
10389	Austell (¾ mile west)	do	Granite gneiss	12,890	163	.56	7.4	5.4	18.7	5	(1)	
10393	Blackwell Station (1 mile north).	do	Hornblende gneiss	17,350	184	.42	4.9	8.2	17.3	7	(1)	
10394	Kennesaw Mountain (north of).	do	do	(1)	180	1.05	(1)	(1)	18.0	7	(1)	
10379	Smyrna (3½ miles west)	do	Magnetic quartzite	(1)	172	.84	(1)	(1)	18.0	7	(1)	
10395	Kennesaw Station (4 miles southwest).	do	Amphibolite	(1)	191	.46	5.3	7.5	15.3	5		20
9869	Lela	Decatur	Siliceous shell limestone	(1)	125	2.51	22.2	1.8	19.3	5		20
11204	Decatur (near)	Dekalb	Biotite gneiss	(1)	162	.65	3.8	10.5	18.0	12	(1)	
11205	do	do	Granite	(1)	161	1.07	7.3	5.5	18.0	6	(1)	
11206	do	do	Biotite gneiss	(1)	168	.73	5.3	7.6	17.3	9	(1)	
12078	Stone Mountain	do	Granite	11,220	164	.63	4.5	8.8	17.3	7	(1)	
11940	Lithonia	do	do	(1)	163	.43	4.6	8.7	17.9	6	(1)	
11941	do	do	do	21,280	165	.50	3.2	12.5	18.0	12	(1)	
11942	do	do	do	15,325	163	.51	4.7	8.5	17.8	6	(1)	

[1] Test not made.

[2] Exact locality not known.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

GEORGIA—Continued.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
11943	Lithonia	Dekalb	Granite	17,830	163	.63	4.0	10.0	18.2	7	(1)
10197	Beach Creek Bridge	Floyd	Calcareous shale	(1)	163	2.14	(1)	(1)	10.7	8	(1)
10199	Lavender Mountain	do	Sandstone	(1)	163	1.47	(1)	(1)	17.7	29	(1)
10198	Huffaker Station	do	Limestone	(1)	170	.22	3.6	11.1	16.0	6	42
10200	Rome (3 miles north)	do	Argillaceous limestone	(1)	168	.21	5.1	7.8	15.7	12	51
10202	Dozier Creek	do	Limestone	(1)	170	.44	5.1	7.8	15.7	4	36
10203	Pinson	do	do	(1)	169	.22	4.9	8.2	15.3	5	39
10211	Rome	do	Argillaceous limestone	(1)	167	.95	5.6	7.1	14.7	13	35
10221	Armuchee (1 mile southeast).	do	Crystalline limestone	(1)	168	.35	5.5	7.3	15.0	6	38
10222	do	do	Oolitic limestone	(1)	168	.20	4.2	9.5	16.0	8	35
10223	do	do	Limestone	(1)	168	1.12	3.8	10.5	16.7	8	61
10224	Armuchee (southeast of).	do	Argillaceous limestone	(1)	167	.59	4.0	10.0	17.3	16	40
9751	Atlanta (near)	Fulton	Biotite granite	(1)	168	.32	3.7	10.8	18.3	8	17
9761	do	do	Gneissoid granite	(1)	165	.34	4.7	8.5	18.0	7	15
9764	Atlanta	do	do	(1)	162	.85	(1)	(1)	19.3	8	24
9753	Atlanta (near)	do	do	(1)	168	.35	3.8	10.5	(1)	(1)	10
9752	do	do	Granite gneiss	(1)	165	.53	(1)	(1)	18.7	9	15
9754	do	do	Biotite gneiss	(1)	165	.94	8.4	4.8	17.3	7	21
9755	Atlanta	do	Mica gneiss	(1)	165	.38	3.0	13.3	18.7	10	19
9756	Atlanta (near)	do	Granite gneiss	(1)	165	.30	4.3	9.3	18.7	7	15
9757	do	do	do	(1)	165	1.01	(1)	(1)	17.2	7	24
9758	do	do	do	(1)	165	.41	4.1	9.8	19.3	13	20
9759	Atlanta	do	do	(1)	168	.30	3.8	10.5	18.3	13	20
9760	Atlanta (near)	do	do	(1)	165	.40	3.5	11.4	18.3	9	25
9762	do	do	Biotite gneiss	(1)	172	1.03	(1)	(1)	14.7	4	35
9763	do	do	Hornblende gneiss	(1)	184	.77	(1)	(1)	19.0	7	32
9765	do	do	Biotite gneiss	(1)	165	.18	5.0	8.0	18.7	6	29
9766	Atlanta	do	Granite gneiss	(1)	165	.36	3.4	11.8	18.0	9	22
9767	do	do	Hornblende biotite gneiss	(1)	175	.26	4.4	9.1	16.7	6	21
10396	Fairmount (½ mile south).	Gordon	Limestone	(1)	169	.27	5.3	7.5	14.7	5	31
10397	do	do	do	(1)	170	.08	4.1	9.8	15.3	6	35
10547	Lawrenceville	Gwinnett	Biotite hornblende schist	(1)	183	.60	(1)	(1)	15.7	5	(1)
10556	Lawrenceville (12 miles northeast).	do	Hornblende schist	(1)	196	.65	6.6	6.1	(1)	(1)	(1)
10553	Lawrenceville	do	Granite gneiss	(1)	159	.62	4.4	9.0	17.0	5	(1)
10564	Rosebud	do	Biotite gneiss	(1)	162	.69	5.6	7.1	18.9	6	(1)

10565	Snellville	do	do	(1)	162	.73	5.5	7.3	17.7	3	(1)
10554	Lawrenceville	do	Granite	(1)	165	.33	5.9	6.8	19.2	6	(1)
10555	Lawrenceville (1½ miles east).	do	do	(1)	162	.86	(1)	(1)	17.7	4	(1)
10557	Lawrenceville (6 miles southeast).	do	do	(1)	162	.72	4.9	8.2	18.4	6	(1)
10558	do	do	do	(1)	162	.61	4.6	8.7	18.0	5	(1)
10559	Grayson (2 miles east)	do	Biotite granite	(1)	158	.71	5.7	7.0	18.0	5	(1)
10560	McElvaney Shoals	do	Gneissoid granite	(1)	162	.71	5.2	7.7	18.2	4	(1)
10561	Grayson (southwest of)	do	do	(1)	162	.67	5.2	7.7	17.5	4	(1)
10562	Langley Quarry	do	Granite	(1)	162	.82	6.7	6.0	17.5	4	(1)
10563	Grayson (3 miles southwest).	do	do	(1)	162	.78	5.5	7.3	18.3	6	(1)
10566	Snellville (2 miles southeast).	do	do	(1)	162	.73	4.0	10.0	18.3	6	(1)
10650	Lawrenceville (4 miles west).	do	Amphibolite	(1)	190	.32	3.4	11.8	18.0	13	12
10543	Pendergrass	Jackson	Olivine diabase	(1)	184	.09	3.6	11.1	19.0	16	22
10554	Talmo	do	Granite gneiss	(1)	161	1.13	7.6	5.2	(1)	5	(1)
10545	Holder siding (near)	do	Hornblende gneiss	(1)	165	.48	4.0	10.0	18.3	7	(1)
10546	Jefferson (4 miles north)	do	Granite	(1)	163	.65	5.6	7.1	18.3	5	(1)
10656	Jefferson (3 miles east)	do	Hornblende schist	(1)	190	.04	(1)	(1)	17.0	4	(1)
10897	Robertsville (1½ miles northeast).	Jones	Argillaceous sandstone	(1)	105	19.80	12.2	3.2	(1)	(1)	(1)
9739	Montbrook	Levy	Chert	(1)	156	2.02	3.2	12.5	(1)	(1)	8
9740	do	do	do	(1)	156	2.74	3.5	11.4	(1)	(1)	78
10384	Upper Marietta	Milton	Granite gneiss	(1)	167	.56	6.6	6.1	18.0	8	(1)
10385	do	do	do	(1)	163	.59	6.9	5.8	18.7	6	(1)
10858	Columbus (4 miles north).	Muscogee	Hornblende gneiss	(1)	179	.25	4.5	8.9	16.7	5	(1)
10859	do	do	do	(1)	179	.45	5.0	8.0	16.7	5	(1)
10861	Fortson (4 miles south)	do	Biotite gneiss	(1)	167	.48	3.7	10.8	18.7	10	(1)
10862	Fortson (1 mile southwest).	do	do	(1)	164	.89	5.3	7.6	18.7	9	(1)
10863	Gentian (3½ miles northeast).	do	do	(1)	163	.50	3.6	11.1	18.7	9	(1)
10864	Columbus (8 miles north).	do	Granite gneiss	(1)	163	.83	4.3	9.3	18.7	7	(1)
10865	Gentian (3½ miles northeast).	do	Hornblende gneiss	(1)	163	.58	3.7	10.8	18.7	10	(1)
10881	Columbus (east of)	do	Granite gneiss	(1)	165	.36	3.9	10.2	18.7	7	(1)
10860	Fortson (2 miles southeast).	do	Biotite granite	(1)	168	.40	4.2	9.5	19.3	8	(1)
11518	Marble Hill	Pickens	Marble	(1)	169	.09	15.7	2.54	11.3	2	(1)
11513	Tate	do	do	(1)	169	.17	13.21	3.03	9.3	2	(1)
11514	do	do	do	(1)	169	.33	11.95	3.34	10.33	2	(1)
11515	do	do	do	(1)	.69	.40	16.98	2.36	3.9	3	(1)
11516	do	do	do	11,340	.71	.37	10.6	3.77	10.33	2	(1)
11517	do	do	do	8,735	169	.40	(1)	(1)	8.6	3	(1)
10776	(2)	(2)	Siliceous limestone	(1)	(1)	(1)	(1)	(1)	17.3	6	61

[1] Test not made.

[2] Exact locality not known.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
			IDAHO.								
10462	St. Anthony	Fremont	Basalt	(1)	159	4.17	7.2	5.6	16.7	4	(1)
			ILLINOIS.								
11224	McCook	Cook	Dolomite	(1)	158	2.33	6.0	6.7	(1)	(1)	50
11226	Thornton	do	do	(1)	157	2.43	6.8	5.9	(1)	(1)	66
11872	do	do	Argillaceous dolomite	(1)	162	2.27	5.5	7.3	13.6	6	23
12236	Whitehill quarry	Johnson	Siliceous limestone	(1)	195	.54	4.9	8.2	14.7	12	40
9750	Aurora	Kane	Smelter slag	(1)	221	.17	2.2	18.2	(1)	(1)	(1)
10367	Kankakee	Kankakee	Dolomite	11,180	158	2.12	8.4	4.8	16.0	5	22
11790	Lehigh	do	Argillaceous dolomite	(1)	157	3.08	7.0	5.7	14.3	7	(1)
10208	Fox Township	Kendall	Dolomite	(1)	169	1.67	4.9	8.2	13.3	8	37
11133	Pontiac	Livinsgton	Argillaceous limestone	(1)	156	2.73	12.9	3.1	(1)	(1)	60
11780	Alton	Madison	Limestone	(1)	166	.93	5.9	6.8	12.7	4	(1)
9827	Joliet	Will	Dolomite	8,130	168	1.18	4.9	8.2	15.1	8	39
10772	Aurora (near)	do	Smelter slag	(1)	212	.00	7.3	5.5	18.7	7	10
			INDIANA.								
9688	(2)	Clark	Argillaceous dolomite	(1)	150	5.23	10.3	3.9	0.0	3	53
11082	Brazil	Clay	Limestone	(1)	174	.66	4.3	9.3	17.3	11	48
11018	Milltown	Crawford	do	(1)	167	.56	3.3	12.1	16.3	11	34
11019	do	do	do	(1)	168	.66	3.6	11.1	15.0	7	21
11020	do	do	do	(1)	167	.60	3.5	11.4	15.3	11	28
11021	do	do	Argillaceous limestone	(1)	168	1.17	3.0	13.3	15.3	11	36
11022	do	do	Limestone	(1)	168	.37	4.5	8.9	16.7	6	35
11023	do	do	do	(1)	168	.61	4.4	9.1	15.7	7	13
11024	do	do	Pisolitic limestone	(1)	158	2.78	5.2	7.7	8.7	4	21
11025	do	do	Limestone	(1)	161	2.59	4.5	8.9	14.7	8	23
9859	St. Paul	Decatur	Argillaceous limestone	(1)	168	2.01	4.4	9.1	14.0	5	23
10114	do	do	do	(1)	168	1.01	4.0	10.0	13.3	5	32
11778	do	do	Limestone	(1)	166	1.62	4.7	8.5	12.3	6	(1)
11066	Schnellville	Dubois	Siliceous limestone	(1)	169	2.58	3.8	10.5	15.3	12	43
11183	Huntington	Huntington	Dolomite	25,420	163	2.10	4.1	9.7	14.0	7	95
9811	Vernon	Jennings	do	(1)	159	4.30	5.0	8.0	15.3	9	63
10834	do	do	Limestone	(1)	167	2.08	3.9	10.2	15.3	9	37

10847	do	do	Dolomite	(1)	149	6.90	8.1	4.9	12.0	4	22
11235	do	do	Argillaceous dolomite	24,150	162	3.67	4.8	8.3	12.3	6	71
11236	do	do	Dolomite	27,490	164	1.45	5.7	7.0	14.7	11	24
11237	do	do	Limestone	15,330	166	1.00	4.5	8.9	13.3	6	59
11238	do	do	Argillaceous limestone	14,840	141	9.27	10.9	3.6	8.0	5	27
10256	Bloomington (east of)	Monroe	Limestone	(1)	(1)	(1)	(1)	(1)	12.0	5	26
10257	Bloomington	do	Argillaceous limestone	(1)	(1)	(1)	(1)	(1)	14.6	5	50
10493	do	do	Limestone	(1)	185	1.03	4.8	8.3	14.7	7	22
9860	Greencastle	Putnam	do	(1)	168	.66	(1)	(1)	16.7	5	46
11818	do	do	do	(1)	167	.66	6.9	5.8	15.3	5	(1)
10727	do	do	do	(1)	160	1.07	7.3	5.5	9.0	3	26
10519	Fillmore	do	Argillaceous limestone	(1)	159	2.22	(1)	(1)	11.2	6	22
10520	do	do	do	(1)	162	2.00	(1)	(1)	12.0	6	18
10020	Elberfeld	Warrick	Limestone	(1)	159	3.81	4.5	8.9	15.3	9	40
9935	Bluffton	Wells	Dolomite	(1)	165	2.89	6.2	6.5	15.0	8	45
10693	(2)	(2)	Limestone	(1)	166	1.24	5.4	7.5	13.5	5	52
10694	(2)	(2)	Argillaceous limestone	(1)	148	8.75	8.9	4.5	0.0	3	29
			IOWA.								
11783	Dubuque	Dubuque	Argillaceous dolomite	(1)	169	1.55	5.7	7.1	15	7	(1)
11614	Council Bluffs	Mills	Limestone	(1)	166	.43	5.4	7.4	15.7	6	17
			KANSAS.								
9599	Fort Scott (7 miles west of).	Bourbon	Limestone breccia	7,380	(1)	(1)	(1)	(1)	(1)	(1)	(1)
11689	Lecompton	Douglas	Cherty limestone	(1)	157	1.01	9.3	4.3	12.0	5	14
11687	Lawrence (near)	do	Argillaceous limestone	(1)	158	2.40	6.1	6.6	8.7	4	14
11684	Lawrence	do	do	(1)	152	3.97	7.6	5.3	4.0	4	13
11683	do	do	do	(1)	154	4.40	10.7	3.7	14.7	6	14
11681	Junction City	Geary	do	(1)	119	12.30	31.8	1.3	0.0	3	12
11682	do	do	Cherty limestone	(1)	134	10.20	13.0	3.1	14.0	2	(1)
11695	do	do	Argillaceous limestone	(1)	149	5.44	13.7	2.9	(1)	(1)	18
11696	do	do	do	(1)	164	1.51	5.7	7.0	14.3	7	14
11686	Tonganoxie	Leavenworth	do	(1)	156	2.91	7.6	5.3	11.3	5	16
11692	Neely	do	Limestone	(1)	155	2.60	8.3	4.8	15.7	6	10
9780	Beloit	Michell	Argillaceous limestone	(1)	143	6.71	18.2	2.2	4.3	4	33
11677	Helmick "A"	Morris	do	(1)	132	8.85	11.5	3.5	16.7	2	11
11678	Helmick "B"	do	do	(1)	122	9.19	30.1	1.3	2.7	3	19
11679	Helmick "C"	do	do	(1)	143	6.59	15.0	2.7	0.0	3	14
11680	Helmick "D"	do	do	(1)	134	9.25	19.5	2.1	0.0	3	14
11693	Council Grove	do	do	(1)	153	3.67	9.1	4.4	11.7	3	11
11691	Topeka	Shawnee	do	(1)	144	7.76	7.2	5.6	13.3	3	15
11690	do	do	do	(1)	151	4.99	7.7	5.2	12.0	5	15
11685	do	do	do	(1)	52	4.72	8.7	4.6	10.3	6	16
11676	Lexis	do	Limestone	(1)	165	1.35	5.1	7.0	13.3	8	19
11688	do	do	do	(1)	156	3.14	7.7	5.2	16.5	6	15

[1] Test not made.

[2] Exact locality not known.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

KENTUCKY.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
11343	Princeton (near)	Caldwell	Cherty limestone	(1)	164	0.48	4.5	8.9	16.7	8	43
10134	Lexington	Fayette	Argillaceous limestone	(1)	168	.19	6.1	6.6	16.0	4	41
10136	do	do	do	(1)	168	.17	5.5	7.3	12.7	4	34
10451	Cerulean Springs (near)	Trigg	do	(1)	167	.45	4.7	8.5	14.2	6	37
9829	(2)	(2)	Limestone	(1)	165	1.31	(1)	(1)	13.7	6	40
9830	(2)	(2)	Argillaceous limestone	(1)	165	.82	(1)	(1)	15.5	10	44

LOUISIANA.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
11241	New Orleans	Orleans	Argillaceous sandstone	(1)	128	11.35	19.1	2.1	14.7	6	(1)

MAINE.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
11483	Auburn	Androscoggin	Biotite gneiss	(1)	170	0.58	4.4	9.1	18.0	8	(1)
10219	North Jay	Franklin	Granite	21,260	164	.84	2.7	14.8	19.3	7	13
11416	do	do	Biotite gneiss	25,090	(1)	(1)	(1)	(1)	17.3	7	(1)
12283	do	do	Granite	(1)	163	.69	4.4	9.1	19.0	11	(1)
9997	Mount Desert	Hancock	do	19,780	165	.21	3.4	11.8	19.7	9	11
10233	do	do	do	19,220	162	.90	4.1	9.8	18.7	8	9
10234	do	do	do	24,700	160	.67	3.2	12.5	18.7	12	14
10988	Ship Harbor	do	do	28,650	165	.21	(1)	(1)	19.3	18	(1)
10989	do	do	do	26,500	163	.31	(1)	(1)	18.7	13	(1)
10990	do	do	do	32,450	164	.42	(1)	(1)	19.3	16	(1)
11327	Hallowell	Kennebec	do	25,380	162	.78	3.0	13.2	18.7	8	(1)
11408	Litchfield	do	Biotite gneiss	(1)	168	.40	4.0	10.0	19.3	6	(1)
11468	Winslow	do	Mica schist	(1)	174	.47	4.1	9.8	15.0	8	(1)
11486	Hallowell	do	Granite	27,760	163	.72	3.2	12.5	18.7	7	(1)
11215	Camden	Knox	Biotite quartzite	18,040	172	.22	3.4	11.8	16.7	11	(1)
9781	St. George	do	Granite	18,780	(1)	(1)	(1)	(1)	(1)	12	(1)
9865	do	do	do	17,150	(1)	(1)	(1)	(1)	18.8	9	(1)
11418	do	do	Biotite granite	25,180	(1)	(1)	(1)	(1)	18.0	10	(1)
10019	Vinal Haven	do	do	21,650	165	.25	3.1	12.9	19.3	14	28
9996	Long Cove	do	Granite	17,540	168	.23	3.3	12.1	19.2	10	30
10249	do	do	Biotite granite	22,500	165	.86	3.0	13.3	19.3	13	(1)

10250	.....do	.....d	Granite	22,330	166	.82	3.5	11.4	19.3	8	(1)
9706	Rockland	.....do	Marble	(1)	175	.40	4.3	9.3	17.0	4	47
11411	Rockport	.....do	Granite	31,580	(1)	(1)	(1)	(1)	18.0	8	(1)
11414	Vinal Haven	.....do	Biotite granite	32,090	(1)	(1)	(1)	(1)	19.3	11	(1)
11404	Richmond	Sagadahoc	Biotite gneiss	(1)	163	1.79	11.4	3.5	17.0	5	(1)
11405	.....do	.....do	Granite	(1)	163	.76	4.1	9.8	18.0	5	(1)
11406	Bowdoinham	.....do	Biotite gneiss	(1)	165	.89	9.5	4.2	17.3	3	(1)
11407	Richmond	.....do	.....do	(1)	170	1.41	8.4	4.8	17.3	3	(1)
11421	Bowdoinham	.....do	Gneissoid granite	(1)	159	1.63	7.1	5.6	(1)	(1)	(1)
11422	.....do	.....do	Biotite gneiss	(1)	163	1.74	12.4	3.2	(1)	(1)	(1)

MARYLAND.

11335	Raspeburg	Baltimore	Horneblende schist	(1)	186	0.41	3.5	11.4	17.3	15	(1)
11336	.....do	.....do	Horneblende gneiss	(1)	165	.89	6.7	6.0	15.0	7	(1)
11556	Bare Hills	.....do	Serpentine rock	(1)	161	1.02	7.7	5.2	12.3	5	(1)
10105	Frederick	Frederick	Limestone	(1)	(1)	(1)	3.0	13.3	16.0	5	(1)
12360	Bel Air (near)	Harford	Altered gabbro	(1)	189	.18	2.6	15.0	18.0	19	(1)
10021	North Laurel	Howard	Amphibolite	(1)	200	.46	3.5	11.4	17.7	8	32
10101	Dickerson	Montgomery	Diabase (trap)	(1)	(1)	(1)	1.4	28.6	18.5	21	(1)
11152	Halpine	.....do	Epidote hornblende gneiss	(1)	198	.65	3.1	12.9	16.0	11	(1)
11153	.....do	.....do	Biotite granite	(1)	171	.42	3.1	12.9	18.7	13	(1)
11342	Cavetown	Washington	Marble	(1)	171	.29	3.6	11.1	16.0	9	51

MASSACHUSETTS.

10016	Great Barrington	Berkshire	Marble	(1)	175	0.37	5.6	7.1	15.3	4	43
11508	Lee	.....do	Dolomitic marble	(1)	179	.31	7.2	5.6	11.2	2	(1)
10288	Otis	.....do	Granite	18,260	166	.71	2.6	15.4	18.0	9	(1)
12473	Windsor	.....do	Quartzite	(1)	164	.24	3.9	10.3	18.7	12	(1)
9770	Fall River	Bristol	Biotite gneiss	(1)	178	.27	2.7	14.8	18.2	17	24
11017	Acushnet	.....do	Chlorite gneiss	(1)	167	.44	2.4	16.6	19.0	17	(1)
10247	Seekonk	.....do	Feldspathic sandstone	(1)	167	.76	4.0	10.0	18.7	12	17
11413	Beverly	Essex	Hornblende granite	28,580	(1)	(1)	(1)	(1)	19.3	9	(1)
12289	.....do	.....do	"A" Biotite syenite "B" hornblende granite	(1)	181	.87	(1)	(1)	17.0	18	[illegible]
9649	Essex	.....do	Granite	19,580	165	.32	3.7	10.8	19.7	10	9
9650	.....do	.....do	.....do	18,125	165	.35	4.4	9.1	19.7	10	17
9651	.....do	.....do	.....do	22,285	165	.33	4.9	8.2	19.3	7	13
9652	.....do	.....do	.....do	18,780	165	.21	3.6	11.1	19.3	11	13
11245	Lynn	.....do	Rhyolite	(1)	165	.28	3.4	11.8	(1)	(1)	48
12256	Newburyport	.....do	Granodiorite	(1)	175	.34	3.6	11.0	18.0	10	(1)
11268	(2)	.....do	Biotite granite	(1)	170	.72	3.1	12.9	18.3	10	(1)
12220	Greenfield	Franklin	Altered diabase	(1)	185	.33	(1)	(1)	18	30	17
12215	Westfield	Hampden	Diabase	(1)	185	.14	2.2	18.2	18	26	131

[1] Test not made.

[2] Exact locality not known.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

MASSACHUSETTS—Continued.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
11795	Ayres	Middlesex	Calcareous quartzite	(1)	168	0.85	6.0	6.6	11	12	(1)
11796	do	do	Granite	(1)	159	1.34	9.4	4.3	17.7	5	(1)
11871	do	do	Biotite gneiss	(1)	168	.30	4.9	8.2	19.0	7	(1)
11720	Groton	do	Granite	22,540	162	.76	5.2	7.7	18.0	8	(1)
12090-A	Malden	do	Altered rhyolite	(1)	[2] 169	[2] .21	[2] 2.8	[2] 14.3	18.7	(1)	[2] 14
12090-B	do	do	do	(1)	[2] 169	[2] .21	[2] 2.8	[2] 14.3	17.3	(1)	[2] 14
12088-A	Medford	do	Altered diabase	(1)	[3] 179	[3] .28	[3] 4.1	[3] 9.8	18	(1)	[3] 12
12088-B	do	do	Fragmental rhyolite	(1)	[3] 179	[3] .28	[3] 4.1	[3] 9.8	18	(1)	[3] 12
12088-C	do	do	Altered rhyolite	(1)	[3] 179	[3] .28	[3] 4.1	[3] 9.8	18.7	(1)	[3] 12
12088-D	do	do	Altered granite	(1)	[3] 179	[3] .28	[3] 4.1	[3] 9.8	18	(1)	[3] 12
12141-A	Melrose	do	Altered rhyolite	(1)	[3] 170	[3] .116	[3] 2.6	[3] 15.4	19.3	17	[3] 18
12141-B	do	do	do	(1)	[3] 170	[3] .116	[3] 2.6	[3] 15.4	18	20	[3] 18
12141-C	do	do	do	(1)	[3] 170	4.116	[3] 2.6	[3] 15.4	18	14	[3] 18
12141-D	do	do	do	(1)	[3] 170	[3] .116	[3] 2.6	[3] 15.4	16.7	(1)	[3] 18
12253	Chelmsford	do	Granite	(1)	162	.85	4.1	9.7	18	10	(1)
12145-A	Stony Brook	do	Altered diabase	(1)	[3] 179	[3] .22	[3] 3.5	[3] 11.4	17.3	13	(1)
12145-B	do	do	Altered granite	(1)	[3] 179	[3] .22	[3] 3.5	[3] 11.4	18.7	11	(1)
12145-C	do	do	Altered rhyolite	(1)	[3] 179	[3] .22	[3] 3.5	[3] 11.4	(1)	16	(1)
12061-A	Waltham	do	Hornblende trachyte	(1)	[2] 180	[2] .32	[2] 2.5	[2] 16.0	17.3	18	22
12061-B	do	do	do	(1)	[2] 180	[2] .32	[2] 2.5	[2] 16.0	18	18	17
12324	West Townsend	do	Granite	(1)	162	1.14	7.4	5.4	18.7	8	(1)
12063-A	Brookline	Norfolk	Altered andesite	(1)	[3] 174	[3] .32	[3] 2.0	[3] 20.0	18	22	[3] 8
12063-B	do	do	do	(1)	[3] 174	[3] .32	[3] 2.0	[3] 20.0	18	(1)	[3] 8
12063-C	do	do	do	(1)	[3] 174	[3] .32	[3] 2.0	[3] 20.0	18.7	(1)	[3] 8
12063-D	do	do	do	(1)	[3] 174	[3] .32	[3] 2.0	[3] 20.0	18.7	(1)	[3] 8
12195	Quincy	do	Slate	(1)	168	.03	4.3	9.3	15.3	18	26
11991-A	Brighton	Suffolk	Feldspathic sandstone	(1)	[2] 166	[2] .75	[2] 7.1	[2] 5.6	18.7	13	(1)
11991-B	do	do	do	(1)	[2] 166	[2] .75	[2] 7.1	[2] 5.6	8.3	4	(1)
12051	do	do	Altered trachyte	(1)	175	.17	5.5	7.2	18.7	(1)	172
12050	Roxbury	do	Altered rhyolite	(1)	168	.43	5.8	6.9	18.7	7	13
12056	do	do	Rhyolite breccia	(1)	167	.18	5.9	6.8	18.7	(1)	(1)
12089-A	Boston (Roslindale)	do	Altered rhyolite	(1)	[3] 166	[3] .23	[3] 3.2	[3] 12.5	19	25	(1)
12089-B	do	do	do	(1)	[3] 166	[3] .23	[3] 3.2	[3] 12.5	18.7	(1)	(1)
12089-C	do	do	do	(1)	[3] 166	[3] .23	[3] 3.2	[3] 12.5	18.3	(1)	(1)
10935	Fayville	Worcester	Granite gneiss	(1)	162	.75	3.0	13.3	18.7	11	(1)
11250	Fitchburg	do	Biotite granite	(1)	166	.79	5.7	7.0	17.9	7	(1)
10089	West Rutland	do	Granite	(1)	164	.16	2.9	13.8	18.6	12	19
10090	do	do	do	(1)	161	.79	6.7	6.0	18.0	7	18
10091	do	do	Biotite gneiss	(1)	168	.89	6.5	6.2	16.3	9	35

MICHIGAN.

9855	Marquette	Marquette	Hornblende gneiss	(1)	184	0.62	(1)	(1)	19.3	22	30
9857	do	do	Amphibolite	(1)	181	.57	(1)	(1)	18.0	17	49
9856	do	do	Altered diabase	(1)	184	.66	(1)	(1)	18.7	25	32
9975	do	do	do	(1)	181	.52	2.1	19.1	19.3	12	27
9976	do	do	do	(1)	175	.42	3.8	10.5	16.0	13	55
9977	do	do	do	(1)	184	.60	3.1	12.9	18.3	11	97
11223	Dundee	Monroe	Limestone	(1)	156	1.32	9.0	4.4	0	4	59
9889	Monroe	do	Dolomite	(1)	175	.64	3.6	11.1	17.0	16	30
9988	do	do	Argillaceous dolomite	11,750	165	3.03	4.2	9.5	(1)	5	22
9989	do	do	do	(1)	175	1.47	4.7	8.5	13.5	5	27
10041	do	do	Dolomite	(1)	172	1.80	3.6	11.1	17.0	17	18
11752	Calcite	Presque Isle	Limestone	(1)	157	1.88	6.9	5.6	5.9	4	16
9888	Sibley	Wayne	do	(1)	159	2.82	12.4	3.2	15.3	6	44

MINNESOTA.

11703	Sauk Rapids	Benton	Biotite granite	(1)	165	0.35	4	10.0	19.0	9	(1)
11704	do	do	do	(1)	163	.48	7	5.7	18.7	7	(1)
11705	do	do	Hornblende granite	(1)	169	.32	3.2	12.5	18.7	8	(1)
11341	Mankato	Blue Earth	Calcareous sandstone	(1)	156	4.8	6.4	6.3	5.3	2	28
10485	Jasper	Rock	Quartzite	(1)	164	.18	2.0	20.0	19.7	17	(1)

MISSISSIPPI.

10287	(4)	Holmes	Sandstone	(1)	144	4.70	7.8	5.1	18.0	8	(1)
11791	Brandon	Rankin	Argillaceous limestone	(1)	156	3.08	5.6	7.2	12.0	5	(1)
10098	New Albany	Union	Sandstone	(1)	156	2.58	7.1	3.6	18.7	7	5

MISSOURI.

11510	Cassville	Barry	Marble	(1)	169	0.70	5.7	7.0	11.7	3	(1)
10169	West Line	Cass	Limestone	(1)	156	1.09	11.5	3.5	13.5	5	[illegible]
10410	(4)	do	do	(1)	167	.53	5.6	7.2	14.7	6	[illegible]
11509	Kansas City	Jackson	Marble	(1)	165	.66	7.5	5.3	8.3	2	[illegible]
10251	Hamburg	St. Charles	Limestone	(1)	167	.63	5.2	7.7	12.3	4	37
10252	do	do	do	(1)	164	.90	7.3	5.5	10.7	3	34
10237	Sinclair	do	do	(1)	167	.73	4.0	10.0	16.0	7	[illegible]
10238	do	do	do	(1)	67	.75	5.1	7.9	15.3	5	[illegible]
11713	University City	St. Louis	do	(1)	[illegible]	3.81	5.2	[illegible]	[illegible]	7	[illegible]
11789	Virgus	do	do	(1)	163	2.1	6.7	5.9	14.0	5	[illegible]

[1] Test not made. [2] Test made on mixture of A and B. [3] Test made on mixture of A, B, C, and D. [4] Locality unknown.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
			NEBRASKA.								
9905	Nehawka	Cass	Argillaceous limestone	(1)	168	0.75	4.7	8.5	16.0	6	42
			NEW HAMPSHIRE.								
11339	Redstone	Carroll	Biotite granite	21,910	161	0.61	5.7	7.0	18.0	7	(1)
12229	do	do	Granite	(1)	162	.65	6.5	6.2	18.0	7	(1)
9946	Fitzwilliam	Cheshire	do	26,100	165	.32	3.7	10.8	17.7	9	15
9893	Marlboro	do	do	15,615	165	.36	6.7	6.0	17.3	8	18
9894	do	do	do	15,255	165	.52	5.7	7.0	19.3	6	23
9895	Fitzwilliam	do	do	10,825	165	.33	3.8	10.5	18.7	9	17
11234	Milford	Hillboro	Biotite granite	18,250	163	.81	3.3	12.1	18.3	7	(1)
11419	do	do	Granite	19,800	(1)	(1)	(1)	(1)	18.0	8	(1)
9994	Allenstown	Merrimack	do	18,110	165	.61	2.5	16.0	19.0	11	23
12185	Webb	do	do	(1)	163	2.30	4.4	9.1	17.0	7	(1)
11711	Dover	Strafford	Siliceous marble	(1)	173	.09	4.8	8.3	17.7	15	11
12325	do	do	Slate	(1)	177	.12	(1)	(1)	14.7	13	33
			NEW JERSEY.								
12263	Upper Montclair	Essex	Altered basalt	(1)	183	0.20	2.9	13.8	18.7	43	59
10795	Lambertville	Hunterdon	Diabase	(1)	183	.46	2.8	14.3	18.7	19	49
12386	do	do	Gabbroitic diabase	(1)	184	.22	3.3	12.1	18.2	29	46
12333	Middle Valley	do	Hornblende gneiss	(1)	189	.11	3.4	11.8	18.0	15	30
11914	Pennington	Mercer	Altered diabase	(1)	182	.24	3.4	11.8	18.3	18	19
11996	Millington	Morris	Basalt	(1)	185	.47	2.2	18.0	16.7	15	77
12421	Morristown	do	Altered gabbro	(1)	170	.71	(1)	(1)	17.7	12	28
9921	Mount Hope	do	Pyroxene granite	(1)	178	.44	2.4	16.7	18.3	9	18
10472	Boundbrook	Somerset	Altered diabase	(1)	184	.06	2.2	18.2	18.7	30	54
12101	do	do	Basalt	(1)	182	.24	2.6	15.2	18.7	35	78
			NEW MEXICO.								
9768	Silver City	Grant	Altered granite porphyry	(1)	156	1.73	3.4	11.8	18.6	18	(1)

NEW YORK.

11505	Wingdale	Dutchess	Dolomitic marble	(1)	177	0.202	9.7	4.1	10.0	3	(1)
12953	Mayfield	Fulton	Argillaceous limestone	(1)	176	.26	3.7	10.8	16.0	16	32
12043	Le Roy	Genesee	Cherty limestone	(1)	165	3.58	5.7	7.0	19.3	8	54
10097	Dolgeville	Herkimer	Dolomite	(1)	173	.66	3.1	12.9	15.3	10	29
11423	Little Falls	do	Horneblende gneiss	(1)	176	.51	3.7	10.8	18.0	13	(1)
12117	do	do	do	(1)	176	.83	4.5	8.9	17.3	8	51
10236	Alexandria Bay	Jefferson	Biotite granite	28,130	(1)	(1)	(1)	(1)	18.7	12	(1)
10319	do	do	Granite	28,900	163	.49	2.8	14.3	18.0	10	12
11903	Amsterdam	Montgomery	Limestone	(1)	162	.29	4.9	8.2	15.3	14	20
10042	Albion	Orleans	Sandstone	20,000	(1)	(1)	3.4	11.8	17.3	9	(1)
10093	Rockland Lake	Rockland	Gabbroitic diabase	(1)	187	.19	3.0	13.3	19.0	13	29
10094	do	do	do	(1)	183	.27	3.6	11.1	19.0	12	67
10771	do	do	do	(1)	189	.28	3.0	13.3	18.7	19	37
10191	Hopkinton	St. Lawrence	Sandstone	35,240	157	2.02	2.8	14.3	18.0	12	7
11504	Gouverneur	do	Marble	10,590	170	.2905	(1)	(1)	10.3	2	(1)
11181	Tusten	Sullivan	Feldspathic sandstone	26,300	171	.64	3.3	12.1	15.3	14	(1)
11182	Collicoon	do	do	22,620	166	1.04	3.0	13.3	14.7	13	(1)
10909	Peekskill (south of)	Westchester	Hypersthene syenite	(1)	179	.62	3.5	11.4	17.0	9	(1)
11199	Yorktown	do	Granite	16,200	168	.77	5.8	6.9	18.0	5	(1)

NORTH CAROLINA.

11344	Sunset Mountain	Asheville	Biotite gneiss	(1)	166	0.33	4.1	9.8	17.3	7	(1)
11345	do	do	do	(1)	171	.24	3.5	11.4	16.7	10	(1)
10193	Cranberry	Avery	Hornblende gneiss	(1)	208	.70	4.3	9.3	(1)	(1)	18
10194	do	do	do	(1)	192	.48	5.5	7.3	(1)	(1)	16
9858	Asheville	Buncombe	Biotite gneiss	(1)	168	.26	4.4	9.1	19.3	7	33
10972	do	do	do	(1)	168	1.35	2.7	14.8	18.0	10	(1)
10973	(2)	do	do	(1)	172	.67	3.7	11.4	18.0	13	(1)
11507	Regal	Cherokee	Marble	(1)	169	.25	6.06	6.6	12.3	3	(1)
12180	Belmont	Gaston	Aplitic granite	(1)	173	.85	2.9	13.8	(1)	(1)	(1)
11751	Waynesville	Haywood	Biotite gneiss	(1)	173	.76	5.7	7.0	18.0	5	(1)
11397	Asheford	McDowell	Dolomitic marble	(1)	178	.41	4.5	8.9	16.0	8	25
9892	Granite Quarry	Rowan	Granite	21,125	(1)	(1)	4.6	8.7	(1)	(1)	(1)
10306	Granite Quarry (near)	do	do	34,860	164	.22	2.0	20.0	18.7	11	(1)
10405	Granite Quarry	do	do	(1)	(1)	(1)	(1)	(1)	(1)	10	(1)
10412	(2)	do	do	20,930	164	.51	2.8	14.3	19.3	9	(1)
10413	(2)	do	do	23,580	162	.43	3.3	12.1	19.0	7	(1)
10770	(2)	do	do	17,800	164	.43	5.2	7.7	19.3	10	(1)
9897	(2)	(2)	do	(1)	162	.55	13.8	2.9	(1)	(1)	14
11200	Salisbury	Rowan	do	26,400	162	.44	2.2	18.2	18.7	9	(1)
11415	do	do	do	28,340	(1)	(1)	(1)	(1)	19.3	7	(1)
12116	Harris (near)	Rutherford	Biotite granite	13,680	166	.56	5.1	7.8	17.3	4	22
11706	do	do	Biotite gneiss	12,290	166	.61	7.1	5.6	16.3	6	(1)
11420	Mount Airy	Surry	Granite	23,990	(1)	(1)	(1)	(1)	18.7	6	(1)
11402	Wendell	Wake	Biotite granite	(1)	164	1.04	4.3	9.3	17.3	4	(1)
11566	Neverson	Wilson	Granite	21,920	165	.34	5.4	7.4	18.7	9	(1)

[1] Test not made.

[2] Locality unknown.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

OHIO.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
9864	Lima	Allen	Dolomite	(1)	165	2.67	3.2	12.5	14.7	7	(1)
10025	do	do	Argillaceous limestone	(1)	168	2.77	3.5	11.4	14.7	12	31
10026	do	do	do	(1)	168	1.96	3.7	10.8	16.0	11	33
10027	do	do	do	(1)	168	2.26	3.6	11.1	15.0	11	34
10305	do	do	Limestone	(1)	169	1.80	4.2	9.5	16.0	6	27
9953	Middletown	Butler	Basic open-hearth slag	(1)	209	2.33	4.1	9.8	(1)	(1)	471
9954	do	do	do	(1)	190	2.74	20.4	1.7	(1)	(1)	191
10516	Farmer	Clinton	Limestone	(1)	171	1.66	5.2	7.6	13.2	4	36
10517	do	do	Siliceous limestone	(1)	167	.49	6.6	6.1	13.7	5	45
11331	Sandusky	Erie	Argillaceous limestone	14,615	167	1.38	3.0	13.3	12.9	9	65
10536	Marble Cliff	Franklin	do	(1)	(1)	(1)	(1)	(1)	15.2	6	27
11202	Kenton	Hardin	Dolomite	(1)	167	2.08	2.7	14.8	15.3	15	48
11225	do	do	do	(1)	164	2.35	2.5	16.0	17.0	10	52
11329	Dunkirk	do	Argillaceous dolomite	26,295	167	2.17	3.4	11.8	15.0	10	52
9883	North Baltimore (Wood County near)	Henry	do	(1)	168	2.61	5.0	8.0	16.0	10	44
11198	Bellevue	Huron	Dolomite	(1)	156	4.89	4.9	8.2	6.0	5	52
11203	Clarksfield	do	Feldspathic sandstone	7,910	136	7.75	7.5	5.3	(1)	5	(1)
9854	Ironton	Lawrence	Blast-furnace slag	(1)	181	1.73	5.8	6.9	16.0	6	21
9890	Waterville	Lucas	Argillaceous dolomite	(1)	168	2.36	3.3	12.1	16.3	11	47
9883	do	do	Dolomite	(1)	168	2.04	2.8	14.3	16.3	14	38
11097	White House	do	Siliceous limestone	(1)	161	2.90	6.2	6.5	9.3	6	41
10537	Piqua	Miami	Dolomite	9,810	156	2.53	10.3	3.9	11.0	4	35
10538	do	do	do	15,150	178	.97	4.8	8.3	15.0	13	30
10532	Centerville	Montgomery	Argillaceous limestone	(1)	(1)	(1)	(1)	(1)	(1)	3	30
10533	do	do	do	(1)	(1)	(1)	(1)	(1)	(1)	5	24
10535	do	do	do	(1)	(1)	(1)	(1)	(1)	10.9	3	37
9945	Rocky Ridge	Ottawa	Dolomite	13,360	175	.41	5.4	7.4	12.0	9	37
9973	Limestone	do	do	(1)	162	(1)	5.5	7.3	12.0	7	38
10539	New Paris	Preble	do	16,480	167	1.12	3.4	11.8	16.2	6	37
12358	Woodville	Sandusky	do	(1)	160	4.14	7.5	5.3	17.0	7	70
11330	Bloomsville	Seneca	Argillaceous limestone	16,565	166	2.22	3.6	11.1	12.5	6	38
11328	Middlepoint	Van Wert	do	27,570	169	1.76	3.8	10.5	15.6	10	61
10346	Luckey	Wood	Dolomite	(1)	162	3.68	7.3	5.5	12.0	6	38
9947	Bowling Green	do	do	(1)	165	1.38	7.5	5.3	12.2	6	33
9957	North Baltimore	do	do	(1)	168	2.08	4.0	10.0	14.3	14	50

OKLAHOMA.

11640	Dewey	Washington	Argillaceous limestone	(1)	166	1.10	5.3	7.6	14.0	5	23
11641	do	do	do	(1)	164	1.14	5.3	7.6	11.3	5	30

PENNSYLVANIA.

9786	Granite	Adams	Gabbroitic diabase	23,435	(1)	(1)	(1)	(1)	15.2	14	(1)
10104	Birdsboro (near)	Berks	Diabase	(1)	(1)	(1)	1.7	23.5	18.7	13	(1)
11733	Yardley (near)	do	Granite gneiss	16,330	165	0.21	4.0	10.0	18.3	15	(1)
11409	Quakertown	Bucks	Diabase	34,040	(1)	(1)	(1)	(1)	18.0	10	(1)
12166	do	do	Hypersthene diabase	(1)	191	.17	2.8	14.3	18.3	25	23
11261	Summit Hill	Carbon	Feldspathic sandstone	15,090	163	.83	4.7	8.5	18.0	10	(1)
12477	Lehigh Gap	do	Quartzite	(1)	165	.42	3.3	12.1	18.7	17	(1)
12478	do	do	Feldspathic quartzite	(1)	178	.35	2.8	14.3	18.7	16	(1)
12181	Catawissa	Columbia	Feldspathic sandstone	(1)	167	.36	2.8	14.3	19.3	17	31
12186	do	do	do	(1)	166	.41	3.2	12.5	19.3	25	24
12361	Conewago	Dauphin	Diabase	(1)	188	.35	2.8	14.3	18.0	20	13
10357	(2)	Delaware	Biotite gneiss	(1)	(1)	(1)	(1)	(1)	18.0	9	(1)
9773	Connellsville	Fayette	Siliceous limestone	(1)	168	.46	2.8	14.3	17.7	13	85
12379	Union Furnace	Huntingdon	Marble	(1)	175	.33	3.9	10.3	15.7	7	46
11255	Duryea	Luzerne	Calcareous sandstone	(1)	167	.41	3.4	11.8	16.7	13	(1)
11352	White Haven	do	Feldspathic quartzite	36,000	(1)	(1)	(1)	(1)	(1)	19	(1)
10518	Montoursville	Lycoming	Argillaceous limestone	23,460	168	.10	6.6	6.1	16.2	6	27
10672	Jersey Shore	do	Siliceous limestone	20,360	166	.44	2.6	15.4	18.2	9	53
12261	Green Lane	Montgomery	Altered slate	(1)	169	.38	2.3	17.4	17.3	24	17
10137	South Bethlehem	Northampton	Blast-furnace slag	(1)	145	4.42	9.3	4.3	13.7	3	103
12234	Dalmatia (near)	Northumberland	Fledspathic sandstone	(1)	166	.43	2.4	16.7	19.5	(1)	33
10429	Mount Carmel	do	Quartzite	(1)	163	.53	3.3	12.1	19.0	13	(1)
9812	Holmesburg	Philadelphia	Biotite gneiss	21,530	165	.58	(1)	(1)	19.0	7	(1)
11410	do	do	do	25,930	(1)	(1)	(1)	(1)	18.7	7	(1)
11190	Shohola	Pike	Feldspathic sandstone	25,250	170	.63	3.2	12.5	16.7	12	(1)
10345	Confluence	Somerset	Calcareous sandstone	24,790	168	.34	3.6	11.1	16.7	7	(1)

RHODE ISLAND.

10171	Lincoln	Providence	Granite gneiss	(1)	170	0.17	3.9	10.3	18.7	12	20
10248	East Providence	do	Feldspathic sandstone	(1)	168	.59	3.6	11.1	18.0	12	16
10467	Westerly	Washington	Granite	(1)	161	.37	3.9	10.3	18.7	9	(1)
11398	do	do	Biotite granite	31,450	162	.37	2.4	16.7	19.3	11	(1)
12445	do	do	Granite	18,260	162	.56	(1)	(1)	18.7	15	(1)

[1]Test not made.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

SOUTH CAROLINA.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
10531	Rion	Fairfield	Biotite granite	25,540	165	0.59	4.4	9.1	18.3	8	(1)
11417	Winnsboro	do	do	22,970	(1)	(1)	(1)	(1)	18	7	(1)
10131	Greenville (17 miles from).	Greenville	Granite	(1)	165	.82	4.4	9.1	18.7	8	18
10129	Greenville	do	Hornblende gneiss	(1)	172	.68	8.0	5.0	17.0	6	40
10130	Beverly	Pickens	Biotite gneiss	(1)	166	.75	4.1	9.8	17.7	4	20
11647	Columbia (near)	Richland	Granite	21,500	165	.99	3.1	12.9	18.0	8	(1)
12380	Spartansburg	Spartansburg	Biotite granite	8,620	165	.57	6.8	5.9	18.5	6	(1)

SOUTH DAKOTA.

10108	Dell Rapids	Minnehaha	Quartzite	(1)	165	0.41	2.8	14.3	19.3	17	5
10894	Sioux Falls	do	do	(1)	163	.27	1.4	28.6	19.3	17	(1)
10895	do	do	Olivine diabase	(1)	190	.37	2.7	14.8	18.7	18	16
10896	Rowena	do	Quartzite	(1)	164	.28	2.7	14.8	19.3	17	(1)

TENNESSEE.

9992	Maryville	Blount	Argillaceous limestone	(1)	168	0.40	3.8	10.5	16.7	6	49
9993	do	do	Limestone	(1)	168	.30	4.3	9.3	15.7	5	39
10292	New Tazewell	Claiborne	Siliceous limestone	(1)	171	1.84	4.2	9.5	13.3	8	31
10326	Harrigate (near)	do	Dolomite	(1)	174	.92	3.2	12.5	16.0	14	19
10327	Harrigate	do	do	(1)	171	1.86	3.6	11.1	13.3	7	21
10446	New Tazewell (near)	do	do	(1)	172	1.20	4.1	9.8	15.3	9	42
10581	New Tazewell	do	Siliceous dolomite	(1)	170	1.93	4.1	9.8	15.2	9	18
10483	Jamestown	Fentress	Sandstone	(1)	145	3.97	10.8	3.7	15.0	4	(1)
11521	Ashbury	Knox	Marble	16,030	169	.30	6.0	6.7	13.3	2	(1)
11519	Knoxville	do	do	(1)	169	.13	7.0	5.7	13.0	3	(1)
11522	do	do	do	9,230	168	.11	(1)	(1)	13.6	4	(1)
11523	do	do	do	(1)	168	.17	6.2	6.5	13.0	3	(1)
11524	do	do	do	29,000	168	.20	5.5	7.3	13.0	3	(1)
9887	Mascot	do	Dolomite	(1)	178	.20	4.1	9.8	16.0	11	49
10315	Madisonville	Monroe	Ferrugineous sandstone	(1)	178	.41	4.0	10.0	17.3	8	(1)
10316	do	do	Siliceous limestone	(1)	169	.46	6.3	6.4	16.7	9	29

10317	do	do	Limestone	(1)	167	.77	8.3	4.8	16.7	9	33
10318	do	do	do	(1)	171	.33	4.2	9.5	17.3	8	26
10323	do	do	Crystalline limestone	(1)	168	.33	6.0	6.6	13.3	5	49
10414	(2)	do	Siliceous dolomite	(1)	174	1.36	3.3	12.1	15.7	18	29
9734	(2)	Pickett	Argillaceous dolomite	(1)	168	2.65	4.3	9.3	13.2	12	55
11520	Knoxville	Knox	Marble	(1)	168	.12	5.5	7.3	13.6	5	(1)
11525	Luttrell	Union	do	(1)	170	.17	6.9	5.8	12.3	5	(1)
11526	Amarco	Loudon	do	(1)	168	.25	6.1	6.6	12.6	3	(1)
			TEXAS.								
10044	(2)	Grayson	Clay limestone	(1)	134	12.80	(1)	(1)	0.0	2	(1)
12488	Longview	Gregg	Ferrugineous conglomerate	(1)	153	9.74	25.8	1.6	9.0	3	47
12489	do	do	Ferrugineous sandstone	(1)	178	4.89	13.7	2.9	13.5	6	(1)
12490	do	do	do	(1)	150	7.21	13.9	2.8	11.3	3	81
12491	Gladewater	do	do	(1)	143	9.06	16.6	2.4	3.8	4	28
11347	Bowie	Montague	Quartz conglomerate	(1)	148	4.34	21.6	1.9	(1)	(1)	(1)
11395	Chico (near)	Wise	Limestone	(1)	169	.30	5.7	7.0	14.3	4	46
			VERMONT.								
12190	Hardwick	Caledonia	Biotite granite	(1)	165	1.11	(1)	(1)	17.0	8	(1)
10848	Burlington	Chittenden	Siliceous dolomite	(1)	163	.26	3.7	11.1	16.7	13	38
11191	Derby	Orleans	Siliceous limestone	(1)	171	.46	3.0	13.3	17.3	9	96
9673	Barre	Washington	Biotite granite	(1)	165	.37	2.8	14.3	19.0	9	19
12209	do	do	do	(1)	165	.47	(1)	(1)	18.0	11	(1)
12200	Bethel	Winsor	Granite	(1)	164	.52	(1)	(1)	18.0	11	(1)
11488	Proctor	Rutland	Serpentine marble	16,050	171	.22	(1)	(1)	18.0	6	(1)
11489	do	do	Variegated marble	12,720	177	.17	(1)	(1)	16.7	16	(1)
11490	do	do	Black marble	18,755	171	.26	4.6	8.7	14.3	9	(1)
11491	do	do	Marble	11,045	170	.32	5.9	6.8	11.0	3	(1)
11492	do	do	do	7,750	167	.55	(1)	(1)	(1)	(1)	(1)
11493	do	do	do	6,945	168	.56	16.9	2.4	.....	2	(1)
11494	do	do	do	9,520	168	.31	7.2	5.6	11.0	2	(1)
11495	do	do	do	7,105	167	.40	9.3	4.3	7.7	2	(1)
11496	do	do	do	7,380	168	.39	10.6	3.8	6.7	3	(1)
11497	do	do	do	7,110	168	.46	(1)	(1)	4.0	3	(1)
11498	do	do	do	8,770	168	.52	6.4	6.2	8.7	3	(1)
11499	do	do	do	10,120	168	.32	7.8	5.1	11.7	3	(1)
11500	do	do	do	9,010	168	.28	7.8	5.1	9.0	3	(1)
11501	do	do	do	12,300	168	.36	4.8	8.3	11.7	4	(1)
11502	do	do	do	8,730	168	.41	7.2	5.5	7.0	3	(1)
11503	do	do	Siliceous marble	40,700	177	.78	(1)	(1)	17.6	24	(1)
11528	do	do	Marble	(1)	168	.45	(1)	(1)	7.3	4	(1)

[1] Test not made.

[2] Exact locality not known.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

VIRGINIA.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
9928	(1)	Albemarle	Biotite gneiss	(2)	175	1.62	5.3	7.5	17.6	7	36
9927	(1)	do	Hornblende gneiss	(2)	193	.98	3.5	11.4	16.3	9	47
9926	(1)	do	Biotite gneiss	(2)	181	.57	5.1	7.8	18.7	7	63
11376	(1)	do	Sericite-epidote schist	(2)	165	.69	5.0	8.0	18.3	7	(2)
11377	(1)	do	Biotite gneiss	(2)	173	1.21	5.4	7.4	18.7	3	(2)
10253	Charlottesville	do	Granite gneiss	(2)	171	.75	5.4	7.4	17.3	5	24
10172	Clifton Forge	Alleghany	Siliceous limestone	(2)	166	.48	2.5	16.0	17.6	10	48
9891	Lone Jack Station	Campbell	Quartzite schist	(2)	159	1.34	12.0	3.3	(2)	(2)	8
9904	do	do	Aplitic granite	(2)	165	.53	5.4	7.4	18.7	7	5
11551	do	do	Quartz	(2)	162	.71	10.9	3.7	(2)	(2)	(2)
11565	Bocock	do	do	(2)	165	.33	15.0	2.7	(2)	(2)	(2)
11779	Halsey (near)	do	Hornblende epidosite	(2)	198	.35	3.9	10.2	16.7	9	(2)
10344	Lynchburg	do	Quartzite	25,885	160	1.20	4.3	9.3	18.6	14	(2)
11251	Lynchburg (near)	do	Quartz	(2)	165	.20	5.8	6.9	(2)	(2)	(2)
11362	do	do	Hornblende gneiss	(2)	178	.80	10.3	3.9	19.3	8	(2)
9819	Cliff View	Carroll	Hornblende schist	(2)	184	.71	4.4	9.1	18.3	14	31
9820	do	do	Altered hornblende gneiss	(2)	181	1.60	15.8	2.5	14.3	5	109
10115	Boston	Culpeper	Altered rhyolite	(2)	168	.84	4.7	8.5	19.0	5	(2)
11394	Clintwood	Dickenson	Feldspathic sandstone	(2)	158	3.14	5.4	7.4	5.0	6	(2)
9919	Warrenton	Fauquier	Amphibolite	(2)	187	.76	4.6	8.7	(2)	(2)	44
9920	do	do	do	(2)	181	2.44	5.9	6.7	(2)	(2)	120
9870	do	do	Epidote chlorite schist	(2)	187	1.46	3.6	11.1	(2)	(2)	43
10304	do	do	do	(2)	185	.63	3.5	11.4	14.7	11	(2)
11246	Bluff City	Giles	Quartzite	(2)	165	.89	3.1	12.9	(2)	(2)	(2)
11248	do	do	Siliceous dolomite	(2)	175	.33	3.6	11.1	(2)	(2)	(2)
11412	Forest Hills	Henrico	Biotite granite	19,270	(2)	(2)	(2)	(2)	18.0	6	(2)
10009	Hamilton (¾ mile east of)	Loudoun	Amphibolite	(2)	178	.49	8.9	10.3	17.3	10	17
10099	Luray	Page	Argillaceous limestone	(2)	167	.75	5.4	7.4	14.3	5	27
10298	Buckland	Prince William	Diabase	(2)	178	1.75	(2)	(2)	17.3	(2)	35
11549	Buena Vista (near)	Rockbridge	Limestone	(2)	176	.78	2.7	14.8	18.3	23	17
11550	do	do	Argillaceous limestone	(2)	173	.20	2.4	16.7	17.0	11	22
11719	Castlewood	Russell	Limestone	(2)	171	.15	3.9	10.3	17.3	13	22
10930	Gate	Scott	Argillaceous limestone	(2)	168	.38	4.1	9.7	16.0	13	35
11272	Front Royal	Warren	Limestone	(2)	171	.57	4.3	9.3	14.3	3	28
10780	Wise	Wise	Sandstone	(2)	158	2.10	4.5	8.8	18.7	10	(2)

WASHINGTON.

10239	Cook (3 miles north of)	Skamania	Basalt	(2)	177	0.92	2.6	15.4	18.3	24	14

WEST VIRGINIA.

11708	Martinsburg	Berkeley	Limestone	(2)	170	0.19	5.9	6.8	14.0	3	15
10064	Martinsburg (south of)	do	Dolomite	(2)	178	.31	3.6	11.1	16.3	10	29
10069	Butts Store	do	Feldspathic sandstone	(2)	140	3.45	7.2	5.6	18.7	(2)	8
10073	Hedgeville (west of)	do	do	(2)	165	.62	2.8	14.3	16.7	(2)	61
10087	Tomahawk (north of)	do	Sandstone	(2)	156	1.66	7.9	5.1	(2)	(2)	23
10062	Inwood (near)	do	do	(2)	144	3.19	16.6	2.4	19.3	2	17
10063	Ferrelridge	do	Limestone	(2)	168	1.61	6.2	6.5	14.0	4	56
10065	Blairton (near)	do	Argillaceous limestone	(2)	168	.19	5.1	7.8	16.7	6	28
10066	Berkeley Station	do	Limestone	(2)	168	.27	6.3	6.4	16.0	4	34
10067	Jones Spring	do	Siliceous limestone	(2)	168	.31	4.4	9.1	17.3	9	44
10068	Bedington (east of)	do	Argillaceous limestone	(2)	172	.19	4.9	8.2	16.0	10	33
10070	Bunker Hill	do	Limestone	(2)	168	.24	5.1	7.8	16.0	4	34
10071	Nipetown	do	do	(2)	168	.43	4.9	8.2	16.0	3	32
10072	Spring Mills	do	do	(2)	168	.27	4.2	9.5	15.0	4	45
10074	Gerrardstown	do	Argillaceous limestone	(2)	172	.46	6.5	6.2	15.7	(2)	22
10075	Bedington (east of)	do	do	(2)	168	.32	5.6	7.1	(2)	(2)	29
10076	Van Clevesville (south of).	do	do	(2)	168	.36	5.0	8.0	17.0	9	(2)
10077	Darkesville	do	Limestone	(2)	168	.31	5.0	8.0	15.0	4	33
10078	Tomahawk	do	Siliceous limestone	(2)	168	.27	4.5	8.9	18.3	15	47
10079	Falling water	do	Limestone	(2)	168	1.27	4.7	8.5	16.7	8	20
10080	Little Georgetown	do	Argillaceous limestone	(2)	175	.37	6.5	6.2	18.7	10	24
10081	Jones Spring	do	Crystalline limestone	(2)	168	.37	5.7	7.0	14.0	4	47
10082	Falling water (near)	do	Limestone	(2)	168	.59	5.6	7.1	(2)	(2)	25
10083	Falling water	do	Chert and limestone (mixed)	(2)	(2)	(2)	4.7	8.5	(2)	(2)	23
10084	Blairton	do	Limestone	(2)	168	.23	5.9	6.8	16.3	5	20
10085	Cumbo	do	do	(2)	172	.52	4.6	8.7	16.7	4	32
10086	Martinsburg (south of)	do	do	(2)	168	.56	5.8	6.9	18.0	5	39
10102	Martinsburg	do	do	(2)	(2)	(2)	5.2	7.7	16.7	6	(2)
10511	Scherr	Grant	Argillaceous limestone	(2)	166	.60	5.4	7.4	(2)	(2)	31
9925	Renick	Greenbrier	do	(2)	168	.66	3.8	10.5	16.3	8	41
9972	Fort Spring	do	Limestone	(2)	168	.24	4.1	9.8	15.7	9	57
11915	Ronceverte	do	do	(2)	168	.18	4.3	9.3	16.7	11	31
11715	White Sulphur Springs	do	Feldspathic sandstone	(2)	164	.84	3.2	12.3	18.3	14	(2)
11763	(1)	do	do	(2)	165	.82	3.0	13.3	18.7	14	(2)
10103	Kearneyville	Jefferson	Limestone	(2)	(2)	(2)	2.7	14.8	14.0	6	(2)
11609	(1)	do	Dolomite	(2)	177	.40	4.5	8.9	16.7	6	18
9966	Greer	Monongalia	Argillaceous limestone	(2)	168	.73	4.7	8.5	15.7	8	40
9967	do	do	do	(2)	168	.59	4.7	8.5	15.7	9	63

[1] Exact locality not known.

[2] Test not made.

TABLE I.—*Results of physical tests of road-building rock from the United States and Canada from Jan. 1, 1916, to Jan. 1, 1918*—Continued.

WEST VIRGINIA—Continued.

Serial No.	Town or city.	County.	Name of material.	Crushing strength, pounds per square inch.	Weight per cubic foot.	Absorption, pounds per cubic foot.	Per cent of wear.	French coefficient of wear.	Hardness.	Toughness.	Cementing value.
9968	Greer	Monongalia	Argillaceous limestone	(1)	168	0.73	4.8	8.3	14.0	9	37
9969	do	do	Siliceous limestone	(1)	168	.56	3.0	13.3	16.7	10	47
10348	Albright (near)	Preston	Sandstone	(1)	154	1.88	8.1	4.9	17.3	5	(1)
10349	Albright	do	Ferrugineous sandstone	(1)	160	2.40	4.0	10.0	15.3	9	(1)
11471	Lester (near)	Raleigh	Sandstone	(1)	150	3.60	9.5	4.2	13.3	5	(1)
11472	Beckley	do	do	(1)	156	3.07	3.1	12.9	15.0	6	(1)
11473	Surveyor	do	do	(1)	155	2.74	4.2	9.5	18.0	6	(1)
11544	Ghent	do	do	(1)	158	2.32	4.2	9.5	17.3	8	(1)
11545	Cherry Glade	do	do	(1)	152	3.14	8.2	4.9	16.7	4	(1)
11546	Daniels	do	do	(1)	155	2.24	4.8	8.3	16.7	7	(1)
11547	Shady Springs	do	do	(1)	156	2.44	4.9	8.2	18.0	6	(1)
11736	Bolt	do	Quartz conglomerate	(1)	151	3.23	31.6	1.3	(1)	(1)	4
11130	Trap Hill District	do	Sandstone	(1)	154	3.69	3.9	10.3	16.6	9	(1)
10336	Spencer (near)	Roane	Feldspathic sandstone	(1)	156	3.52	12.3	3.3	8.7	4	32
10509	Davis	Tucker	Siliceous limestone	(1)	167	.05	3.7	10.8	14.3	10	30
10510	do	do	Argillaceous limestone	(1)	168	.12	5.0	8.0	16.3	6	37

WISCONSIN.

11971	Springdale	Dane	Dolomite	(1)	172	1.27	3.7	10.8	16.0	12	21
9999	Berlin	Green Lake	Rhyolite	(1)	165	.16	1.9	21.3	19.0	25	15
10168	Buffalo	Marquette	Altered syenite	(1)	167	.13	2.2	18.2	19.3	30	13
10014	Wauwatosa	Milwaukee	Argillaceous dolomite	(1)	168	2.11	3.7	2.8	14.7	8	(1)
11129	Wauwatosa (near)	do	do	16,700	168	2.01	3.8	10.5	15.3	11	62
11367	do	do	Argillaceous limestone	20,370	163	3.2	2.1	19.0	14.0	8	18
10986	Wells	Monroe	Calcareous sandstone	(1)	162	2.79	4.8	8.3	18.0	5	(1)
9970	Black Creek	Outagamie	Dolomite	(1)	178	.58	4.6	8.7	14.7	9	31
9971	do	do	do	(1)	178	.53	4.1	9.8	15.3	8	31
10022	Belgium	Ozaukee	Argillaceous dolomite	(1)	175	1.15	7.4	5.5	14.3	8	30
11625	Mequon	do	Dolomite	22,750	174	1.09	3.4	11.8	12.3	7	16
11638	do	do	do	(1)	178	1.13	5.6	7.1	15.0	7	(1)
11447	Red Granite	Waushara	Granite	(1)	165	.33	1.4	28.5	19.3	14	(1)
10159	Grand Rapids	Wood	Sandstone	(1)	153	1.91	3.3	12.1	18.3	5	3
10028	(2)	(2)	Dolomite	(1)	168	1.05	7.1	5.6	13.3	6	41

CANADA.

11648	Ottawa (south of)	Province of Ontario	Argillaceous dolomite	(1)	166	3.05	4.8	8.3	13.7	4	18
11649	Ottawa (east of)	do	Limestone	(1)	167	.56	4.9	8.2	12.0	4	27
9746	Welland	do	Cherty limestone	(1)	165	.41	3.9	10.3	18.3	13	82
11650	Hull (near)	Province of Quebec	Diabase	(1)	184	.54	2.4	16.7	18.0	13	28
10017	Montreal	do	Nephelite syenite	(1)	156	.60	2.2	18.2	18.7	18	22
10332	Wellesley Island	do	Biotite granite	(1)	165	.28	2.9	13.8	18.0	10	(1)

Test not made.

[2] Exact locality unknown.

TABLE II.—*Results of compression tests of rock, made prior to Jan. 1, 1916.*

ARKANSAS.

Serial No.	Locality.	County.	Name.	Crushing strength, pounds per square inch.
6331	Bald Knob	White	Sandstone	19,860

CONNECTICUT.

9791	Oneco	Windham	Biotite granite	16,635

ILLINOIS.

4422	Embarras	Coles	Limestone	17,300
5509	Thornton	Cook	Dolomite	23,060
6053	do	do	do	16,880
8711	Hillside	do	Argillaceous dolomite	15,730
4660	Tunnel Hill	Johnson	Sandstone	19,150
7509	Reevesville	do	Argillaceous limestone	25,780
7510	do	do	do	28,400
4764	Kankakee	Kankakee	Dolomite	20,610
5550	do	do	do	17,710
6088	do	do	Argillaceous dolomite	20,830
6165	do	do	Dolomite	11,660
6865	do	do	do	13,500
7298	do	do	Argillaceous dolomite	25,850
7299	do	do	do	20,000
7300	do	do	do	19,800
7301	do	do	do	19,700
7302	do	do	Dolomite	17,050
7871	Lehigh	do	Argillaceous Dolomite	16,700
4421	Alton	Madison	Limestone	15,100
7422	Brookville	Ogle	Argillaceous dolomite	18,640
7423	do	do	do	18,180
5549	Anna	Union	Limestone	19,510

INDIANA.

5534	Loganport	Cass	Limestone	20,350
4655	Greensburg	Decatur	Dolomite	17,960
4658	St. Paul	do	Limestone	18,400
4690	Westport	do	Dolomitic limestone	20,000
4659	St. Paul	do	do	20,510
5088	do	do	Limestone	19,800
4197	Mitchell	Lawrence	Argillaceous dolomite	12,250
5027	Bedford	do	Limestone	6,900
5029	do	do	do	6,450
3368	Greencastle	Putman	do	16,000
5737	Osgood	Ripley	do	14,470
4657	Wabash	Wabash	Dolomitic limestone	18,790

IOWA.

5525	Cedar Rapids	Linn	Dolomite limestone	19,950
5526	La Grande	Marshall	do	14,850

KENTUCKY.

5552	Princeton	Caldwell	Dolomitic limestone	23,860
7688	Cedar Bluff	do	Argillaceous limestone	25,720
5921	Limestone	Carter	Limestone	14,900
5922	Carter	do	Siliceous limestone	13,400

TABLE II.—*Results of compression tests of rocks, made prior to Jan. 1, 1916*—Contd.

MAINE.

Serial No.	Locality.	County.	Name.	Crushing strength, pounds per square inch.
7438	Swans Island	Hancock	Biotite granite	18,400
8745	Vinal Haven	Knox	Granite	20,020
8768	St. George	do	do	22,800
8769	Vinal Haven	do	do	20,930
8781	St. George	do	do	18,780
9865	do	do	do	17,150
9996	Long Cove	do	do	17,540
9445	Vinal Haven	do	Biotite granite	21,220
10366	St. George	do	do	27,050
7439	Frankford	Waldo	do	20,600

MARYLAND.

5611	Mount Savage Junction.	Allegany	Siliceous limestone	34,930
4884	Frederick	Frederick	Limestone	17,580
5694	Havre de Grace	Harford	Gneissoid granite	34,410
5695	do	do	Sericite geniss	20,090
5696	do	do	Gneissoid granite	21,670
5697	do	do	Amphibolite	34,380
5698	do	do	Gneissoid granite	35,210
5699	do	do	do	22,190

MASSACHUSETTS.

6891	Rockport	Essex	Biotite granite	22,370
6892	do	do	do	23,610
6893	do	do	do	22,670
6894	do	do	do	21,600
8796	do	do	do	23,830
5671	Westfield	Hampden	Altered diabase	32,850
8862	Westford	Middlesex	Granite	13,980
8874	do	do	do	17,000
8875	do	do	do	16,250
5988	West Auburn	Worcester	Mica gneiss	21,950

MICHIGAN.

9593	Calcite	Presque Isle	Limestone	10,300

MINNESOTA.

5524	Stockton	Winona	Argillaceous dolomite	16,000

MISSOURI.

6375	Rochefort	Boone	Limestone	13,900
6377	Sweeney	Cooper	Argillaceous limestone	14,900

NEW YORK.

6457	(1)	Clinton	Plagioclase gneiss	18,500
6458	(1)	do	Pyroxene gneiss	20,500
8011	(1)	Dutchess	Dolomite	34,450
5544	Camelo	do	do	29,050
5872	Akron Junction	Erie	Cherty limestone	16,700
6056	do	do	do	31,180
8577	Gloversville	Fulton	Biotite gneiss	14,585
4157	Alexandria Bay	Jefferson	Granite	21,600
8833	do	do	do	26,180
8902	do	do	do	14,150
9129	do	do	do	14,390
9130	do	do	Gneissoid granite	17,600
7437	do	do	Granite	27,200
8012	(1)	Rockland	Gabbroitic diabase	31,300
8013	(1)	do	Siliceous dolomite	22,200

[1] Exact locality not known.

TABLE II.—*Results of compression tests of rock, made prior to Jan. 1, 1916*—Continued.

NEW HAMPSHIRE.

Serial No.	Locality.	County.	Name.	Crushing strength, pounds per square inch.
8872	Melford	Hillsboro	Granite	15,050
9010	do	do	Biotite granite	16,640
9011	do	do	do	14,870
9012	do	do	do	18,230
9031	Concord	Merrimack	Granite	16,600
9036	do	do	do	13,420
9037	do	do	do	13,900
8870	do	do	do	15,100

NORTH CAROLINA.

8396	(1)	Forsythe	Granite	13,140
8397	(1)	do	Hypersthene gabbro	11,880
8682	Spencer Mountain	Gaston	Feldspathic quartzite	31,520
8881	Gastonia	do	Quartzite	17,100
8576	Mooresville	Iredell	Biotite granite	26,000
5373	(1)	McDowell	Sandstone	22,600
9038	Wilson	Wilson	Granite	16,070
5956	Stacey	Rockingham	Granite gneiss	23,220
5496	Sansbury	Rowan	Granite	33,750
6071	Bostic	Rutherford	Biotite gneiss	16,100
5497	Mount Airy	Surry	Granite	18,400
7433	do	do	do	15,200
8901	do	do	do	5,100
9048	do	do	do	16,440
8419	Granita (near)	Wake	Biotite granite	14,160
3807	Wise	Warren	Granite	18,240
3808	do	do	do	18,560
5374	(1)	Yancey	Quartzite	12,900

OHIO.

4694	Osborne	Clark	Dolomitic limestone	8,690
4695	Springfield	do	Dolomite	18,960
9282	Cleveland	Cuyahoga	Granite	31,790
9283	do	do	do	27,900
9284	do	do	do	24,790
9285	do	do	do	26,990
9459	do	do	do	24,900
4378	Sandusky	Erie	Limestone	19,400
5554	do	do	do	21,850
5753	Castalia	do	Dolomitic limestone	18,530
6055	do	do	Limestone	20,810
5505	Marble Cliff	Franklin	do	16,750
5506	do	do	do	12,350
5630	Columbus	do	Ferrugineous sandstone	21,800
4693	Patterson	Hardin	Dolomite	11,360
5553	Dunkirk	do	do	26,200
4707	Hillsboro	Highland	Cherty limestone	15,590
8347	Clarksfield	Huron	Calcareous sandstone	9,490
4656	Big Springs	Logan	Argillaceous limestone	16,380
6054	Vulcan	Lucas	Siliceous limestone	25,480
6057	Holland	do	Argillaceous limestone	19,430
8402	Toledo, 10 miles west of	do	Dolomite	11,600
6052	White Rock	Ottawa	do	16,620
5556	Bloomville	Seneca	Limestone	20,250
5555	Middleport	Van Wert	Dolomite	25,200

OKLAHOMA.

3388	Granite	Greer	Granite	18,000

[1] Exact locality not known.

TABLE II.—*Results of compression tests of rock, made prior to Jan. 1, 1916*—Continued.

PENNSYLVANIA.

Serial No.	Locality.	County.	Name.	Crushing strength, pounds per square inch.
5602	Hyndman	Bedford	Impure limestone	21,150
5603	do	do	Siliceous limestone	21,860
5632	Birdsboro	Berks	Altered diabase	39,215
8724	Juniata	Blair	Argillaceous limestone	15,480
8725	(1)	do	do	20,880
8625	Hazard	Carbon	Blast-furnace slag	9,000
7973	(1)	Chester	Proxene quartzite	31,800
7978	(1)	do	Mica schist	23,500
7979	(1)	do	do	23,900
5578	Salona	Clinton	Argillaceous limestone	18,710
7844	(1)	Dauphin	Siliceous limestone	26,500
8306	(1)	do	Limestone	8,510
8427	(1)	do	do	19,250
8465	(1)	do	Siliceous dolomite	9,640
8049	(1)	Elk	Ferruginous sandstone	14,150
5771	Indian Creek Station	Fayette	Calcareous sandstone	37,740
6097	Bidwell	do	Limestone	13,450
9347	Connelsville	do	do	26,050
5604	Water Street	Huntingdon	Feldspathic sandstone	22,330
5557	Walford	Lawrence	Limestone	27,500
6153	Porter Township	Lycoming	Argillaceous limestone	28,580
6154	do	do	do	26,860
6155	do	do	do	18,610
6156	do	do	do	22,930
6157	do	do	Limestone	21,900
6158	do	do	do	14,160
7980	Port Allegheny	McKean	Feldspathic sandstone	9,680
8022	(1)	(1)	Ferruginous sandstone	12,130
8023	(1)	(1)	do	11,000
8024	(1)	(1)	do	12,480
3243	McSpadden	Somerset	Sandstone	26,900
5830	Prompton	Wayne	Feldspathic sandstone	26,340
5605	Blairsville intersection	Westmoreland	Siliceous limestone	32,560
7428	York	York	Dolomitic marble	27,400

RHODE ISLAND.

8867	Westerly	Washington	Granite	11,740
8868	do	do	do	20,300
8869	do	do	do	20,750

SOUTH CAROLINA.

8389	Williamstown	Anderson	Granite	12,990
5568	Rion	Fairfield	do	29,180
5586a	do	do	do	25,790
5586b	do	do	do	19,240
5586c	do	do	do	33,880

TENNESSEE.

5597	Quarry	Carter	Limestone	22,750
5502	Straw Plains	Jefferson	do	21,730
5504	do	do	do	28,340
5503	do	do	Dolomite	38,070
6533	Knoxville	Knox	Marble	17,970

VERMONT.

5543	East Wallingford	Rutland	Altered diabase	16,800
8853	Barre	Washington	Granite	19,560

[1] Exact locality not known.

TABLE II.—*Results of compression tests of rock, made prior to Jan. 1, 1916*—Continued.

VIRGINIA.

Serial No.	Locality.	County.	Name.	Crushing strength, pounds per square inch.
8804	Albert	Bedford	Granite gneiss	13,820
6796	(1)	Dinwiddie	Granite	13,150
4900A	Broad Run	Fauquier	Quartz	28,400
4900B	do	do	Epidosite	28,000
5923	Strathmore	Fluvanna	Chlorite epidote schist	13,210
5678	Eggleston (near)	Giles	Dolomite	45,690
5924	Boscobel	Goochland	Granite gneiss	13,550
6615	Korah Station	Henrico	Biotite granite	20,300
5925	Greenway	Nelson	Feldspathic quartzite	16,500
5492	Nokesville	Prince William	Ferruginous sandstone	17,780
5920	Greenlee	Rockbridge	Dolomitic marble	36,900
5382	Bluff Water Station	Rockingham	Limestone	21,450
5385	do	do	do	40,850
5375	St. Paul	Russell	do	17,600
7217	Burkes Garden	Tazewell	Dolomitic sandstone	21,500

[1] Exact locality not known.

WEST VIRGINIA.

5365	Berkeley	Berkeley	Limestone	23,350
5917	Renick	Greenbrier	Crystalline limestone	21,300
5918	Frazier	do	Limestone	17,450
5919	Snow Flace	do	do	13,550
7475	Green Spring (east of)	Hampshire	Siliceous limestone	34,400
7476	do	do	Quartzite	15,050
6109	Spring Hill	Kanawha	Sandstone	12,400
9132	Fairmont	Marion	do	5,420
9133	do	do	do	5,720
9134	do	do	do	6,080
5610	Sturgisson	Monongalia	Siliceous limestone	22,440
5612	do	do	Limestone	17,910
5613	do	do	Argillaceous limestone	14,300
5614	do	do	Calcareous sandstone	29,840
5615	do	do	Impure limestone	19,650
5616	do	do	Argillaceous limestone	24,850
8447	Parkersburg	Wood	Feldspathic sandstone	11,910

WISCONSIN.

5523	Pebbles	Fond du Lac	Dolomite	32,600
3448	Amberg	Marinette	Biotite granite	20,000
8656	Lannon	Waukesha	Dolomite	23,020

TABLE III.—*Geographical distribution of rock samples tested to Jan. 1, 1918.*

Alabama	32	Kansas	33	New Jersey	82	Utah	13
Arizona	4	Kentucky	47	New Mexico	1	Vermont	55
Arkansas	20	Louisiana	8	New York	155	Virginia	439
California	103	Maine	103	North Carolina	162	Washington	213
Colorado	28	Maryland	126	Ohio	173	West Virginia	193
Connecticut	56	Massachusetts	220	Oklahoma	52	Wisconsin	154
Delaware	31	Michigan	97	Oregon	14	Wyoming	3
Florida	13	Minnesota	21	Pennsylvania	625	Canada	55
Georgia	272	Mississippi	14	Rhode Island	43	Cuba	4
Idaho	10	Missouri	43	South Carolina	33	Porto Rico	12
Illinois	134	Montana	4	South Dakota	15		
Indiana	185	Nebraska	12	Tennessee	85	Total	4,325
Iowa	25	New Hampshire	34	Texas	69		

TABLE IV.—*General limiting test values for broken stone.*

Type of construction.	Traffic.[1]	Limiting values.		
		French coefficient of wear.	Toughness.	Hardness.
Water-bound macadam, plain or with dust palliative treatment.	Light	5 to 8	5 to 9	10 to 17.
	Moderate	9 to 15	10 to 18	14 or over.
	Heavy	16 or over	19 or over	17 or over.
Macadam with bituminous carpet	Light to moderate	5 or over	5 or over	(2)
Bituminous macadam with seal coat	Moderate to heavy	7 or over	10 or over	
Bituminous concrete	Light to moderate	7 or over	7 or over	(2)
	Moderate to heavy	10 or over	13 or over	
Binder course for sheet asphalt or Topeka type.	Any	7 or over	6 or over	(2)
Portland cement concrete	Moderate to heavy	7 or over	8 or over	
Stone paving block [3]	Any	8 or over	9 or over	16 or over.
Broken-stone foundations	do	3 or over	3 or over	8 or over.
Cement-concrete foundations				

[1] Light traffic is assumed as less than 100 vehicles per day, moderate traffic between 100 and 250 vehicles, and heavy traffic over 250 vehicles per day.
[2] Numerous tests have shown that limits for hardness are unnecessary if the material possesses the required French coefficient of wear and toughness.
[3] Crushing strength, 20,000 pounds or over per square inch, is frequently required.

Cementing values should in all cases show over 25 if material is to be used in water-bound macadam construction.

Granites, gneisses, schists, sandstones, and quartzites should not, in general, be used in the wearing course of water-bound macadam roads. Shales and slates should never be used in this connection. Cementing value tests have therefore been discontinued on these materials.

For further details and explanation of results in this table and also for tests on all materials to January 1, 1916, see United States Department of Agriculture Bulletin No. 370.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 671

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. PROFESSIONAL PAPER. June 21, 1918

THE DIAGNOSIS OF BEE DISEASES BY LABORATORY METHODS.

By Arthur H. McCray,
Apicultural Assistant,
and
G. F. White,
Expert Engaged in the Investigation of Bee Diseases.

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INTRODUCTION.

Already some of the States have established laboratories for the diagnosis and investigation of the diseases of bees. The number of State laboratories where a rapid and accurate diagnosis of suspected material can be made will no doubt increase in the future in proportion as State laws for bee-disease inspection and control are instituted and perfected. Inspectors realize that there will be always some suspected brood and many conditions among adult bees which can not be diagnosed in the field, but which will require laboratory methods for diagnosis. In addition to the demands made by inspectors for the examination of suspected material, there will be numerous independent requests from beekeepers.

During the past several years the writers have examined a large number of specimens of suspected brood and bees sent to the Bureau of Entomology, and have developed and perfected methods and technique in the diagnosis of the known diseases of bees which, it is believed, will prove valuable to others. It is the aim of this paper to present these methods of diagnosis for the benefit of those who may engage in similar work.

For the understanding and application of the methods herein outlined, a preliminary training in general bacteriology, supplemented by a special knowledge of the pathogenic bacteria and the methods pursued in the diagnosis of diseases in general, is essential. As efficiency depends largely upon a knowledge of pathology, too much emphasis can not be given to it. With such general and special training as a basis, and with a knowledge of the bee diseases, the acquisition of the special methods necessary for a laboratory diagnosis of them becomes a comparatively simple matter.

One of the authors (White) began his investigations on the diseases of bees in 1902, and from this date to 1909 examined and diagnosed about 500 samples of suspected material and during the period developed the laboratory methods as given in the present paper. Since 1909 the senior author (McCray) has carried on the work of diagnosing the samples received by the Bureau of Entomology and up to the present time has examined and diagnosed about 5,000 of them.

LABORATORY METHODS.

OBTAINING THE SAMPLES.

For a satisfactory diagnosis of suspected brood the material at hand should be adequate. The size of the comb containing the affected larvæ should be ample. A piece about 5 inches square is suitable, provided it contains a sufficient number of larvæ. All samples, no matter how far sent or how long in transit, should be inclosed in wooden boxes to prevent crushing during transportation. Pasteboard boxes are apt to allow the sample to be crushed, while samples inclosed in tin boxes are often covered with a rich fungous growth when received. Both the crushing of the sample and the fungous growth obscure the gross features which form an important part of the examination. The sample should not be wrapped in cloth or paper, as this will tend to retain moisture and further encourage fungous growth. If thin paper is used, it frequently adheres so closely that its complete removal is difficult. The sample should contain no honey, as a small amount of it in a comb is sometimes sufficient to cause an unsightly mass, owing to leakage through the package in transit. As complete a history as can be obtained should accompany each suspected specimen as an aid to diagnosis. The Bureau of Entomology for several years past has sent out a printed question card with blank spaces for answers by the beekeeper sending the suspected brood. Some of the more important of these questions are as follows:

1. Is there any bee disease in your neighborhood?
2. If so, what disease?
3. Have you brought colonies from a distance? If so, give source.

4. Have you fed honey from other sources than your own apiary? Give source if known.
5. Is the diseased brood mostly capped or is it mostly uncapped?
6. What is the color of the larvæ (grubs) soon after death?
7. Later, what is the color of the decaying larvæ?
8. Are the dead larval remains ropy?
9. Do you notice any disagreeable odor in the hive?
10. Does there seem to be an unusual number of queenless colonies in the apiary?
11. What disease do you suspect?
12. Give location of the apiary from which sample was taken by town (or township) and county.

While a diagnosis sometimes can be made from larvæ which have been removed from their cells, and sent without the comb, such material is not satisfactory. It is far better to examine the infected larvæ in the comb in which they die. The diagnosis of bee diseases should not be based upon the examination of honey alone.

EXAMINATION OF THE SAMPLES.

In diagnosis both gross and microscopic examinations are made of the suspected material.

GROSS EXAMINATION.

The following points are to be taken into consideration: Character of the caps; regularity of the brood; proportion of affected brood; position of diseased larvæ within the cell; age, color, consistency, and odor of the affected brood; and kind of larvæ affected, whether queen, drone, or worker brood. These factors will be taken up in detail as each brood disease is considered separately.

In the gross examination of the comb it should be held in such a manner that a good lighting of the interior of the cells is secured. This is especially important in examining for scales. The best method of examining suspected brood is to hold the comb in a vertical position and about level with the eyes; then, by gradually inclining the top of the comb toward the observer, a point is reached at which the greatest amount of light is thrown upon the floor of the cells. This brings out the scales with great prominence and permits of their close scrutiny within the cells. In examining the affected brood for consistency and adherence to the cell walls in the scale stage, a small pair of curved forceps is convenient.

The gross examination of the adult bees will be considered under Nosema disease.

In routine diagnostic work unstained water mounts have been found very satisfactory in searching for spores, and stained preparations are made for the vegetative forms. Carbol fuchsin is a suitable stain to use.

MICROSCOPIC EXAMINATION.

The number of larvæ or pupæ to be examined in a given sample depends upon various factors. If the case is a typical one, one larva or pupa dead of a disease usually is sufficient. If, on the other hand, the gross appearance is not so definite and the microscopic picture from the first dead remains examined is unsatisfactory, others must be studied. While much might be written concerning the microscopic appearance of smears from larvæ or pupæ affected with the various brood diseases, as compared each with the others and with smears from healthy brood, such elaborate descriptions are not deemed advisable in this paper. Only the more salient features of the microscopic picture will be given for each disease considered, as it is believed that such descriptions will best serve those for whose benefit the paper is prepared.

It will be understood that when the authors write of the recognition of certain organisms by microscopic examination, as, for example, that of *Bacillus pluton* or *Bacillus alvei*, either in stained smears made from tissue or in stained smears made from agar plates, they refer to the recognition of the organism under observation only in a general way, meaning rather that the microscopic picture suggests the organism. The identification of the organism is complete, naturally, only after a consideration of its cultural characteristics also.

CULTURES.

In culturing the affected brood agar as ordinarily prepared in the laboratory is used in making plates. Those larvæ or pupæ are selected which upon microscopic examination have shown evidence of disease. Of course as many additional ones may be cultured as desired. The cultures are incubated for different periods of time, as will be noted in the discussion of the diseases.

Dead, not living, larvæ are examined.—In the laboratory examination of diseased bee brood, the affected larvæ are always received dead, therefore nothing will be said relative to symptoms and appearance of affected living larvæ.

DISEASES TO BE DIAGNOSED.

EUROPEAN FOULBROOD.

European foulbrood is an infectious disease of the brood of bees caused by *Bacillus pluton* (White, 1912).

GROSS CHARACTERS.

(*a*) *The caps and regularity of the brood.*—Larvæ that die of European foulbrood do so usually before they reach the age at which brood is capped. Brood dead of the disease is therefore usually found in uncapped cells. When the larvæ die after capping

the caps usually are entire, but may be punctured. The caps may be slightly sunken, but usually are not. Owing to the fact that such a small percentage of the affected brood becomes sealed, a comb of brood affected with European foulbrood with its few sealed cells and large amount of young uncapped brood presents a distinctive appearance (Pl. I, fig. 1) and shows a marked contrast to the solid areas of brood of uniform age in healthy combs.

(*b*) *Proportion of affected brood.*—European foulbrood usually has made rather extensive ravages by the time the beekeeper detects it; hence in many samples received for diagnosis a very large proportion of the larvæ in the comb are affected. Toward autumn, however, it is not unusual to receive samples containing a small number of affected larvæ.

(*c*) *Position of larvæ within the cell.*—The usual position for larvæ affected with European foulbrood is that of lying curled at the bottom of the cell. Other affected larvæ lie extended in the cell, but these are few in number.

(*d*) *Age of the dead larvæ.*—In most of the specimens received for diagnosis by far the larger proportion of the affected larvæ are young, lying curled at the bottom of the cell as just stated. Besides this comparatively young brood, older larvæ, including a few sealed ones, may be found affected.

(*e*) *Color.*—A change in color is one of the first abnormalities noted in brood dead of European foulbrood. Yellow or gray and combinations of these two colors are among the first to be noted. Later the yellow and gray gradually deepen, until quite a dark brown is attained. Larvæ dead of this disease often present a peculiar appearance, as though they were melting away under the influence of heat. The transverse tracheal branches stand out prominently. This melting appearance of the larvæ, the yellow, gray, and brown coloration, prominent tracheal branches, and large amount of uncapped affected brood are characteristics not easily confused, in the majority of cases, with those of other diseased conditions of the brood.

(*f*) *Consistency.*—Larvæ dead of European foulbrood are comparatively friable. However, larvæ which are somewhat viscid usually may be found. Perhaps slimy, rather than viscid, expresses better the consistency of some of these larvæ.

(*g*) *Odor.*—A slight, inoffensive odor is frequently to be noted in European foulbrood. The yeastlike odor which has been described is not constant in brood affected with European foulbrood. A similar odor may be detected in samples other than those which contain European foulbrood.

(*h*) *Kind of brood affected.*—Sometimes samples are received which contain only affected drone-brood. Most cases, however, consist only of worker-brood. Queen larvæ also may be attacked.

(*i*) *Scales.*—Scales are formed by the drying of the affected larvæ, and from the foregoing description of the dead brood some conception may be gained as to their form and appearance. Scales of European foulbrood, like most of the affected larvæ, are small and lie at the bottom of the cell, from which they can be separated with ease. The color of the scale is in general yellow, gray, or brown, and the cross markings formed by the transverse tracheal branches usually are still in evidence. This is the usual type of scale found in European foulbrood. Occasionally there will be received, however, a sample containing only a few scales, or perhaps a single scale, in marked contrast to the scale just described. These scales are always few in number in a given comb area, are usually dark brown in color, are less easily removed than the small ones, and are not brittle but rubberlike in consistency.

MICROSCOPIC FINDINGS.

The appearance of *Bacillus pluton*, the etiological factor in European foulbrood, in stained preparations usually is sufficiently characteristic to render its microscopic identification comparatively certain. Besides *Bacillus pluton*, the following secondary invaders may be found: *Bacillus alvei*, *Streptococcus apis*, *Bacillus vulgatus*, *Bacillus mesentericus*, *Bacillus orpheus*, and *Bacterium eurydice*. Without careful observation *Bacillus pluton* and *Streptococcus apis* might be confused. Upon careful examination it is found that *Bacillus pluton* presents considerable variation in size and morphology in the individual organisms. Some of them occur in the form of cocci, yet the general picture is that of an organism with more or less pointed ends. Thin smears should be made in order to obtain details of morphology.

It is important to have a true conception of the microscopic appearance of *Bacillus pluton*. The essential facts are the typical morphology and the manner of grouping of the individual organisms. The general shape of the group is often more or less circular, although numerous groups of more or less irregular form may be observed. Groups of varying shapes and sizes will be noted as successive fields are brought into view. It is the presence of these groups, containing a sufficient number of organisms with the pointed ends described, that serves to differentiate *Bacillus pluton* from *Streptococcus apis*. *Streptococcus apis* usually occurs in forms which are sufficiently coccuslike to lead to little or no hesitancy in differentiating it from *Bacillus pluton*. Forms which are sufficiently pointed to resemble *B. pluton* do occur, however, and if only a few are present in a field the differentiation of these species is not possible. By making a sufficient number of smears from a sufficient number of larvæ, forms

in abundance typical of either *B. pluton* or *Strep. apis* usually can be found. In stained smears of *Strep. apis* the organisms are found to be spread out over the whole field with no tendency to grouping as in the case of *B. pluton*. Sometimes in examining European foulbrood larvæ the microscopic picture shows practically nothing but *B. pluton*. More often, however, *Strep. apis*, *B. alvei*, and other rod forms are found. Some larvæ will disclose *B. alvei* alone, others *Strep. apis* alone, and still others, these two organisms without *B. pluton*. Continued search is sometimes necessary before larvæ are found revealing *B. pluton*, either alone or with one or more of the secondary invaders just mentioned. The authors have found *Bacillus pluton* in the small yellow, gray, and brown scales as well as in the soft melting larvæ. They are not prepared, however, to state the length of time that the organism persists in the dried state. Mention has been made of larger scales of rubberlike consistency which occur only occasionally and in small numbers in a given comb. Such scales always yield microscopically *Bacillus alvei* in abundance, and usually this organism alone. The microscopic appearance of *B. alvei* in the spore stage is rather characteristic, the spores practically always showing vestiges of the rods clinging to them. This aids in differentiating it from *B. vulgatus* and *B. mesentericus*. *Bacillus orpheus* may be recognized microscopically in the spore stage by the position of the spore in the rod, it being eccentrically placed. *Bacterium eurydice* is a small, slender organism which does not form spores.

CULTURES.

At the present writing no medium suitable for growing *Bacillus pluton* has been devised, hence agar plates made from European foulbrood larvæ show only the secondary invaders—*B. alvei*, *Strep. apis*, *B. vulgatus*, *B. mesentericus*, and *B. orpheus*. *Bacillus alvei* is encountered very frequently and is always secured on culturing larvæ in which the microscopic examination has revealed the presence of the organism. *Streptococcus apis* occurs occasionally. *Bacillus vulgatus* and *B. mesentericus* frequently are met, but usually in small numbers only. *Bacillus orpheus* in large numbers is occasionally encountered. *Bacterium eurydice*, as a rule, does not appear in the cultures. *Bacillus alvei* is the only organism occurring with any marked degree of frequency and in any great numbers on agar plates made from affected larvæ of any of the known infectious brood diseases of bees. Rarely do cultures from larvæ dead from any cause other than European foulbrood show the presence of this species.

The appearance of *B. alvei* on agar plates is rather characteristic. The colonies usually occur in abundance, often being innumerable.

When a few colonies are present there is seen, under low magnification, a granular center for each colony surrounded by numerous smaller but similar growths. There is little chance for error in the identification of *B. alvei*, assuming that the gross characters of the suspected material cultured had suggested European foulbrood and that the microscopic examination of the material had suggested the organism.

Cultures should be incubated until the second day in making a diagnosis of suspected European foulbrood material, since spores of *B. alvei* are not produced in abundance until that time. Two days, then, is the minimum time in which a report can be rendered on this disease. *B. vulgatus*, *B. mesentericus*, and *B. orpheus* may be recognized, when present, by their morphology and cultural characteristics (McCray, 1917).

AMERICAN FOULBROOD.

American foulbrood is an infectious disease of the brood of bees caused by *Bacillus larvae* (White, 1907).

GROSS CHARACTERS.

(*a*) *The caps and regularity of the brood.*—A large amount of the affected brood is capped, and many of the caps may be sunken and many perforated. The coloration, the sunken and perforated caps, and the irregularity produced by the capped and uncapped cells present quite a characteristic appearance (Pl. I, fig. 2).

(*b*) *Proportion of affected brood.*—The proportion of affected to healthy brood in American foulbrood is, as a rule, high, although specimens secured early in the attack may show a considerable proportion of unaffected brood.

(*c*) *Position of the larvæ within the cell.*—Inasmuch as most of the larvæ in American foulbrood die after the time of capping, the position of the larvæ is that of extension along the floor of the cell. But the dead larvæ quickly lose their form and symmetry, so that a dark, shapeless mass soon occupies the lower portion and bottom of the cell.

(*d*) *Age of the affected larvæ.*—The usual age at which the larvæ are found dead of American foulbrood is just after the time of sealing. This fact is of importance in considering the size of the scale and its position within the cell. Rarely is young unsealed brood found affected in this disease.

(*e*) *Color.*—Most of the dead larvæ when received for diagnosis will be of a dark chocolate color. Only rarely are larvæ of the lighter shades of brown seen. The late stages of decay are very dark brown.

(*f*) *Consistency.*—The consistency of the affected larvæ is characteristic and pathognomonic. The larvæ are strikingly viscid, so

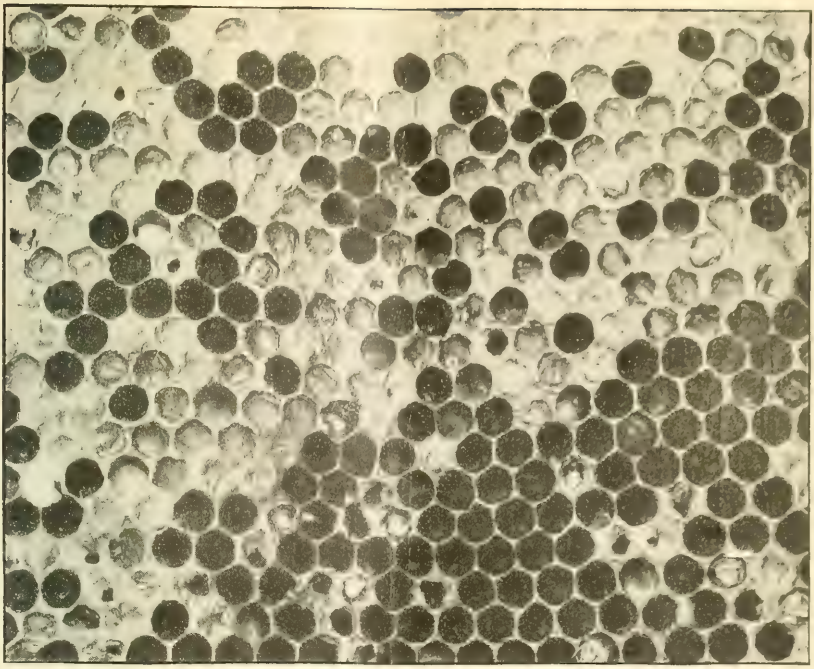

FIG 1.—COMB CONTAINING LARVÆ DEAD OF EUROPEAN FOULBROOD.
About natural size. (Original.)

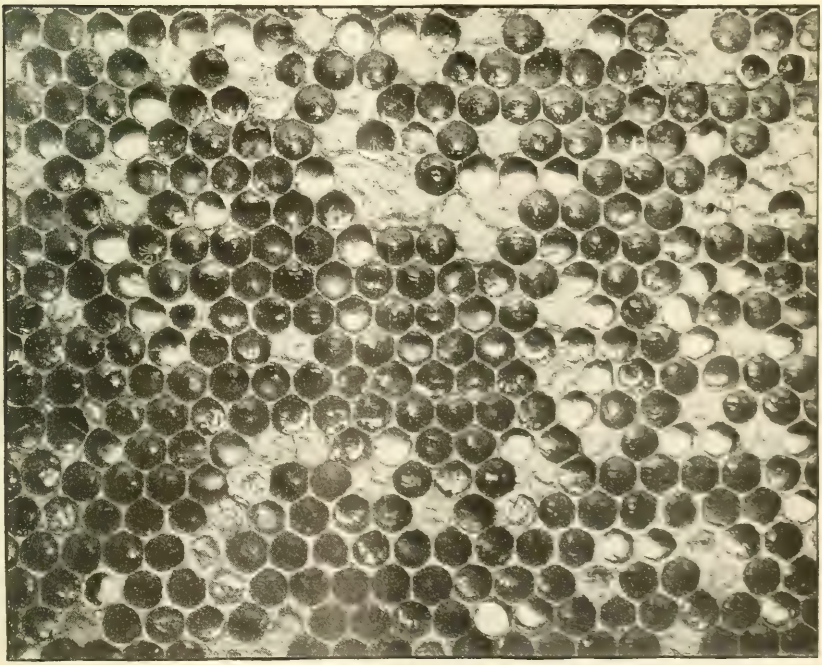

FIG. 2.—COMB CONTAINING LARVÆ DEAD OF AMERICAN FOULBROOD.
About natural size. (Original.)

EUROPEAN AND AMERICAN FOULBROOD.

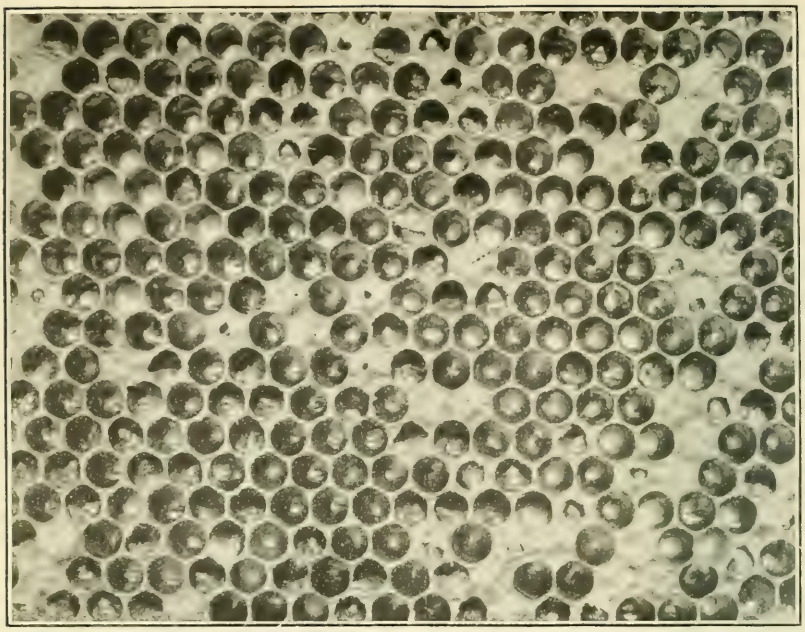

FIG. 1.—COMB CONTAINING LARVÆ DEAD OF SACBROOD.
Natural size. (White.)

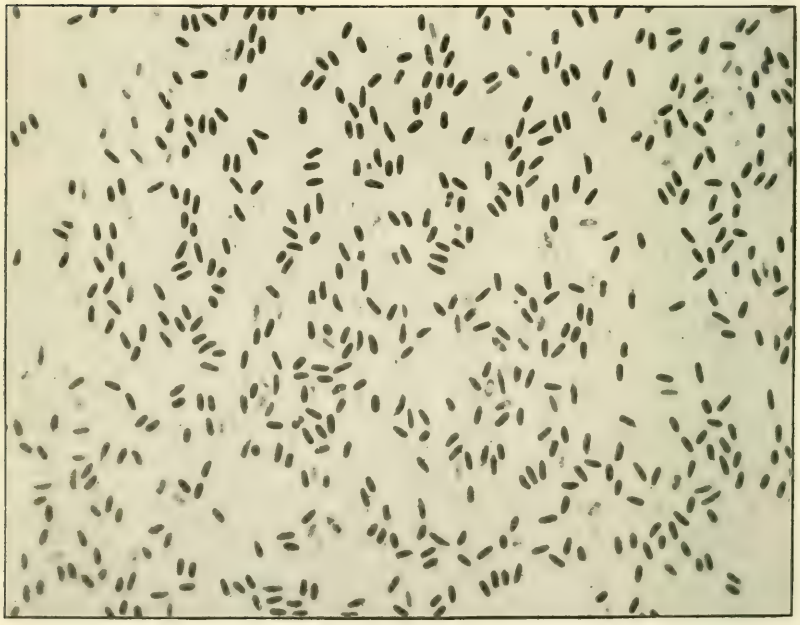

FIG. 2.—STAINED SMEAR PREPARATION SHOWING SPORES OF NOSEMA APIS.
Highly magnified. (Original.)

SACBROOD AND NOSEMA SPORES.

that on thrusting the forceps into the brown larval remains and withdrawing them a portion of the decaying mass adheres and is drawn out, often to a distance of 3 or 4 inches. The viscidity is often referred to by the term "ropiness" in beekeeping literature. In the rare instances in which young uncapped affected larvæ are encountered the ropiness is less pronounced.

(*g*) *Odor.*—The odor is characteristic and may be described as unpleasant. Often it is feeble or absent altogether, probably having disappeared after the removal of the diseased brood from the hive. Affected brood-comb will absorb other odors if given the opportunity, thus masking the original characteristic odor. Such disappearance and masking of the odor has been observed where specimens of diseased brood in combs from various sources had been thrown together and allowed to lie about preparatory to being destroyed (McCray, 1916).

(*h*) *Kind of brood.*—It is affected worker-brood that is most often encountered in American foulbrood samples, although drone-brood is sometimes affected.

(*i*) *Scales.*—The scales of American foulbrood are distinctive and are characteristic of the disease. If they are present in sufficient numbers the disease can be diagnosed from the gross appearance alone. The lower cell walls can be easily illumined by tilting the upper portion of the comb toward the observer, as previously described. The scales appear extended along the lower cell wall, are quite dark in color, and adhere closely to the floor and base of the cell. Sometimes they adhere so closely as to break when an attempt is made to remove them from the cell. Often a semblance of the form of the pupæ is evident in the dried-down mass forming the scale. Some of the mouth parts of the pupæ sometimes protrude sufficiently to adhere to the roof of the cell.

MICROSCOPIC FINDINGS.

In considering the microscopic appearance of stained smears from infected brood in this disease, there usually is only *Bacillus larvæ* in the spore form to engage the attention of the observer. In some instances, however, samples containing the disease in its earlier stages are received and then *Bacillus larvæ* in the rod or vegetative form may be encountered. Such a sample usually is more difficult to diagnose. To receive a sample in which some older larvæ containing spores of *Bacillus larvæ* can not be found, however, is a very rare occurrence.

In a stained smear made from an infected larva and mounted in water, the microscopic picture is rather characteristic. The most striking feature of the mount is the large number of spores adhering to the cover glass, floating with the current, or dancing free in

the water medium. Many of the spores stain slightly about the periphery, which aids somewhat in the observation. Good results may be obtained from an unstained water mount. The vegetative forms of *Bacillus larvae*, when they are present, are observed to be slender rods, which tend to occur in chains.

CULTURES.

In culturing affected larvæ it is the absence of growth on the agar plates that is important in the diagnosis of American foulbrood. This is because the spores of *Bacillus larvae* will not germinate and grow on the ordinary media of the laboratory, and other growth is absent because there are seldom secondary invaders present. Occasionally there will be a spreading growth of *B. vulgatus*, or *B. mesentericus*, and very rarely of *B. alvei*. On quite rare occasions a considerable number of colonies of *B. vulgatus* or *B. mesentericus* have been found. As both of these species form spores, as a rule, within 24 hours, their differentiation from *B. alvei* usually can be made in this way. A report on a sample of American foulbrood, therefore, nearly always can be made within a day.

SACBROOD.

Sacbrood is an infectious brood disease of bees caused by a filterable virus (White, 1913 and 1917).

GROSS CHARACTERS.

(*a*) *Character of caps and regularity of the brood.*—Larvæ usually die after capping in this disease, some of the dead brood being uncapped by the bees later. Occasionally the caps are punctured. An area of comb affected with sacbrood therefore presents an irregularity. So far as the age of the affected larvæ themselves is concerned, there is considerable uniformity owing to the fact that death in this disease occurs after sealing during the two-day period of rest just preceding pupation. The affected brood, however, is interspersed among healthy brood of varying age, which adds to the irregular appearance of the affected comb (Pl. II, fig. 1).

(*b*) *Proportion of affected brood.*—As a rule there is not a large proportion of affected brood in a given comb area. Often there will be an affected larva only here and there.

(*c*) *Position within the cell.*—The position of the affected larvæ is that of extension lengthwise along the floor of the cell, against which the dorsal portion of the larva lies. The head is turned upward, toward the roof of the cell.

(*d*) *Age.*—The brood dies after it has been sealed.

(*e*) *Color.*—Usually by the time brood is received for diagnosis the color of the affected larvæ is brown or quite dark—often almost black. If the brood is in the earlier stages of decay, however, the

color may be light yellow, light gray, or light brown. The lighter shades soon deepen to the darker ones.

(*f*) *Consistency.*—The consistency is characteristic. The cuticular portion of the body wall of an affected larva is decidedly resistant so that the larva may be grasped with forceps and removed from the cell intact. After removal from the cell the larva has the appearance of a small closed sac. When the sac is ruptured the contents will be seen to be watery. Suspended in the waterlike fluid will be noted numerous fine brown granules.

(*g*) *Odor.*—There is no distinctive odor to sacbrood combs.

(*h*) *Kind of brood.*—The greatest ravages occur in the worker-brood. Affected drone-brood may be encountered.

(*i*) *Scales.*—The scales when dried down are quite black and the surface appears somewhat roughened. They separate readily from the cell wall and may be lifted out intact by means of forceps.

MICROSCOPIC FINDINGS.

The striking feature of the microscopic examination is the absence of microorganisms. Rarely a few rods may be observed. A large amount of detritus is always in evidence, consisting of the brown granular material seen on gross examination after rupturing the body wall of the larva. These granules are in a large part the result of the disintegration of the fat body of the larva.

CULTURES.

As might be expected from the microscopic examination, agar plates inoculated with infected material are practically always negative as to bacterial growth. Even the presence of organisms of the *vulgatus* group is rare. No other growth occurs unless from chance contamination.

OTHER ABNORMAL CONDITIONS OF THE BROOD.

There are noninfectious abnormal conditions of the brood of bees which have been confused with one or more of the infectious diseases. Among the more important of these may be mentioned chilled brood, starved brood, overheated brood, drone-brood resulting from laying workers, and brood dying after removal from the hive. The names given to most of the foregoing conditions are sufficient to indicate in a general way the probable cause of death. These conditions are less likely to be confused with American foulbrood than with either one of the other two infectious brood diseases of bees. The specimens that resemble European foulbrood in the gross consist of soft, easily ruptured, gray, yellow, and light-brown larvæ. The irregularity of the brood, the age, the color, and sometimes the scales bear a striking resemblance to many cases of the disease.

On microscopical examination of the affected larvæ the smear often discloses microorganisms, yet they lack the definite, clear-cut,

positive picture desired in the diagnosis of the disease. If, on culturing, the agar plates are free from *Bacillus alvei* the specimen is usually considered negative.

Occasionally specimens are received resembling sacbrood that tend to cause confusion. The head in some of these has a tendency to turn upward, resembling sacbrood, but unless there is present the tough body wall and watery granular contents, a diagnosis of sacbrood should not be made. A resemblance to the disease is sometimes noted after the brood dries down to form a scale, dark in color and separating readily from the cell wall. The microscopic examination and the cultures are often negative as in sacbrood. In such cases, when there are only a few affected larvæ, it is impossible to make a diagnosis. Samples of comb containing only pollen without brood or scales have been received for diagnosis. Such specimens are always unsatisfactory and insufficient for diagnosis.

TABLE 1.—*Differential features in the diagnosis of the brood diseases of bees by laboratory methods.*

	European foulbrood.	American foulbrood.	Sacbrood.
General appearance of brood.	Brood irregular. Large amount of affected brood unsealed.	Very irregular; affected brood sealed, sunken and perforated caps present.	Brood less irregular, perforated caps present, dark sunken caps not so pronounced as in American foulbrood.
Proportion of affected brood.	Varying number of young larvæ affected, usually many.	Usually a large amount of brood affected.	Small amount of brood affected.
Position within cell	Usually curled at bottom. Larvæ soft, with melting appearance.	Extension along lower cell wall. Larvæ soon become a shapeless mass.	Extension along lower cell wall. Head turned upward. Normal form maintained.
Age of the larvæ	Usually die before capping	Usually die after capping	Almost invariably die after capping.
Coloration	Larvæ yellow, gray, and brown.	Usually dark chocolate	Soon become dark brown to almost black.
Odor	Slight, inoffensive	Usually strong characteristic odor. More or less offensive.	None.
Consistency	Soft, rather friable	Viscid, can be "roped" out a distance of 3 or 4 inches.	Contents watery and granular. Larvæ can be removed from cell without rupturing body wall.
Kind of brood affected	Often considerable amount of drone-brood as well as worker-brood.	Any considerable amount of drone-brood less likely to be seen.	Greatest ravages among worker-brood.
Scales	Usually small and lie at bottom of cell. Yellow, gray, or brown in color. Sometimes a few larger, brown, rubberlike scales. All scales separate readily from cell wall.	Extension along lower cell wall dark brown in color. Surfaces somewhat smooth. Separate from cell with difficulty.	Extension along lower cell wall. Dark in color, often black. Somewhat roughened appearance. Separate readily from cell wall.
Microscopic findings	*Bacillus pluton* always. *Bacillus alvei* usually. *Streptococcus apis* sometimes. *Bacillus orpheus*, *Bacterium eurydice*, *Bacillus vulgatus*, and *Bacillus mesentericus*, occasionally.	Usually only *Bacillus larvae*. Occasionally *Bacillus vulgatus* and *Bacillus mesentericus*.	Negative as a rule.
Cultures	Any of the above organisms except *Bacillus pluton*.	Frequently negative. Never *Bacillus larvae* on common media.	Nearly always wholly negative.

NOSEMA DISEASE.

Nosema disease is an infectious disease of adult bees. It is the only adult disease which at the present time can be diagnosed by laboratory methods (White, 1918). Sixty years ago Dönhoff (1857) observed an infectious condition among adult bees in which, upon examining the stomach of affected bees, small oval bodies were found. This work had been practically forgotten until Zander (1909) reported some interesting findings in a disorder of adult bees. He found that the stomach wall of bees taken from colonies suffering from what he called "malignant dysentery" contained a protozoan parasite. To this parasite he gave the name *Nosema apis*.

In England (Graham-Smith, Fantham, Porter, Bullamore, and Malden, 1912) Nosema infection in bees has been associated with a disorder referred to as the Isle of Wight bee disease. Recent investigations in Scotland (Anderson and Rennie, 1916) have lead to a somewhat different view. As *Nosema apis* occurs in the group Microsporidia the name "microsporidiosis" has been given to the disease (Fantham and Porter, 1912).

Nosema disease is widely distributed. It occurs in Germany, Australia, Switzerland, and England at least. The junior author (White, 1914) has found the parasite *Nosema apis* in samples of bees from a large number of the States of the United States and from Canada. The disease weakens and even kills colonies and is therefore one of interest to beekeepers. The exact losses from it are not known, but in America they are less than has been attributed to it in some other countries.

OBTAINING THE BEES.

Either dead or living bees are suitable for examination. Dead bees may be dry and still be suitable material. Living bees for examination can be sent very satisfactorily in mailing cages such as are used by queen breeders; dead ones may be sent in any convenient way. A complete history of the colony and apiary as to disease should accompany the bees.

GROSS CHARACTERS.

The presence of various symptoms has been mentioned as being of importance in the diagnosis of Nosema infection. Among these are noted the spotting of the hive with feces, abdominal distention, the presence of shiny bees devoid of hair, and the activity of the bees, either in the cages or when free. These are of questionable value. It is upon the presence or absence of Nosema spores that the diagnosis is based. Bees otherwise apparently healthy may, upon examination of the stomach, show the presence of spores of *Nosema apis* in large numbers.

MICROSCOPIC FINDINGS.

The bees if alive may be killed easily by crushing the thorax between the jaws of a pair of dissecting forceps. Then the thorax is grasped by the thumb and finger of one hand, the tip of the abdomen is grasped with a pair of forceps held in the other, and by gentle traction the ventriculus (stomach) and hind gut usually come away entirely and may be teased apart for examination, or the whole gut may be crushed under a cover glass and examined. In making a diagnosis at least 10 bees should be examined. Spores of *Nosema apis* if present are easily recognized, being oval, highly refractile bodies (Pl. II, fig. 2). Usually they occur in large numbers crowding the field. They stain with difficulty, and for diagnostic purposes water mounts unstained are satisfactory. The young forms of the parasite when present are quite difficult of detection, and should not be depended upon in the diagnosis.

Occasionally protozoa other than *Nosema apis* have been encountered in the examination of adult bees. These have no relation to Nosema disease, however, and may be disregarded in its diagnosis.

LITERATURE.

Much has already been written on bee diseases. The journals on beekeeping contain numerous articles pertaining to them. Bulletin No. 98 of the Bureau of Entomology briefly reviews a number of papers, published prior to 1912, dealing with the causes of these diseases. The papers reviewed and the publications cited, together with the papers in the following list and the references which they contain, comprise a fairly comprehensive résumé of all the literature detailing work done on these diseases.

With regard to further papers to appear soon, it is announced that studies have been made on American foulbrood and European foulbrood similar to those on sacbrood (White, 1917) and Nosema disease (White, 1918) and that the results are now being prepared for publication.

ANDERSON, JOHN, and RENNIE, JOHN.
1916. Observations and experiments bearing on "Isle of Wight" disease in hive bees. *In* Proc. Roy. Phys. Soc. Edinb., Session 1915–1916, v. 20, pt. 1, p. 23–61, 1 pl.

ARISTOTLE. (B. C. 384–322.)
1783. Histoire des Animaux d'Aristote avec la Traduction Françoise (Notes sur l'Histoire des Animaux d'Aristote) par M. Camus [Greek and French on opposite pages]. Paris. 2v. 4°.
Volume 1, Book IX, page 615: Bee diseases.

1910. The works of Aristotle Translated into English under the Editorship of J. A. Smith [and] W. D. Ross. Oxford. v. 4, Historia animalium by D'Arcy Wentworth Thompson.
Book IX, p. 626b: Bee diseases.

CHESHIRE, F. R., and CHEYNE, W. W.
1885. The pathogenic history and history under cultivation of a new bacillus (B. alvei), the cause of a disease of the hive bee hitherto known as foul brood. *In* Jour. Roy. Micros. Soc. [London], ser. 2, v. 5, pt. 2, p. 581–601, pl. 10, 11.

DZIERZON, JOHANNES.
1882. Dzierzon's Rational Bee Keeping; or the Theory and Practice of Dr. Dzierzon. Translated from the latest German edition by H. Dieck and S. Stutterd. Edited and revised by Chas. Nash Abbott. London.

DÖNHOFF and LEUCKART.
1857. Ueber die Fadenpilz im Darm der Biene. *In* Bienen-zeitung [Eichstädt], v. 13, no. 6, p. 66–67.

FANTHAM, H. B., and PORTER, ANNIE.
1912. The morphology and life history of *Nosema apis* and the significance of its various stages in the so-called "Isle of Wight" disease in bees (Microsporidiosis). *In* Ann. Trop. Med. and Parasit., v. 6, no. 2, p. 163–195, col. pl. 14–16.
Page 189: References.

GRAHAM-SMITH, G. S., FANTHAM, H. B., PORTER, ANNIE, BULLAMORE, G. W., and MALDEN, W.
1912. Report on the Isle of Wight bee disease (Microsporidiosis). *In* Sup. 8 to the Jour. Bd. Agr. [London], v. 19, no. 2. 143 p., 5 pl.
Pages 139–143: Bibliography.

MCCRAY, A. H.
1916. Some difficulties in gross diagnosis of the infectious brood diseases of bees. *In* Jour. Econ. Ent., v. 9, no. 1, p. 192–196.
1917. The spore-forming bacteria of the apiary. *In* U. S. Dept. Agr. Jour. Agr. Research, v. 8, no. 11, p. 399–420, 6 fig., pl. 93–94.

MOLITOR-MÜHLFELD.
1868. Die Faulbrut, ihre Entstehung, Fortpflanzung und Heilung. *In* Bienen-zeitung [Eichstädt], Jahrg. 24, Nro. 8, p. 93–97.

SCHIRACH, A. G.
1771. Histoire Naturelle de la Reine des Abeilles, avec l'Art de Former des Essaims. Le Haye.

WHITE, G. F.
1907. The cause of American foul brood. U. S. Dept. Agr. Bur. Ent. Circ. 94. 4 p.
1912. The cause of European foul brood. U. S. Dept. Agr. Bur. Ent. Circ. 157. 15 p., 10 fig.
1913. Sacbrood, a disease of bees. U. S. Dept. Agr. Bur. Ent. Circ. 169. 5 p.
1914. Destruction of germs of infectious bee diseases by heating. U. S. Dept. Agr. Bul. 92. (Contribution from the Bureau of Entomology.) 8 p.
1917. Sacbrood. U. S. Dept. Agr. Bul. 431. (Contribution from the Bureau of Entomology. Professional paper.) 54 p., 33 fig., 4 pl.
Literature cited, p. 53–54.
1918. Nosema disease. U. S. Dept. Agr. Bul. —. (Contribution from the Bureau of Entomology. Professional paper.) (In press.)
Literature cited.

ZANDER, ENOCH.
1909. Tierische Parasiten als Krankheitserreger bei der Biene. *In* Münchener Bienen-zeitung, 1909, Heft 9. 11 p., 3 fig.

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E. W. NELSON, Chief

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THE DUCK SICKNESS IN UTAH.

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INTRODUCTION.

Since 1910, annual losses from disease of large numbers of wild ducks in the Salt Lake Valley have attracted much attention from sportsmen and others interested in waterfowl. Thousands of these birds find suitable breeding grounds in the marshes formed in the deltas of the rivers draining into Great Salt Lake, while the great extent of these areas and the abundant food supply found there attract vast hordes of others that pass in migration during spring and fall. Early reports of losses from disease among these birds were exaggerated in many cases, but it soon became evident that ducks were dying in such numbers as to make it a serious matter. In the first years the trouble was little understood. Various theories advanced as to its cause were one by one rejected. Local interest was greatly aroused, and many attempts at investigation were made. It was recognized that the problem was of great importance, as a serious mortality among wild ducks in Utah would soon be reflected in a diminution in their numbers in other regions, some perhaps far distant.

Dead ducks from the affected areas were sent in to the Biological Survey and were transmitted to the Bureau of Animal Industry for

Note.—This bulletin is a final report on an investigation of mortality among ducks and other waterfowl in marshes about Great Salt Lake, Utah. It is for the information of sportsmen and others interested in the conservation of game birds. A preliminary report was published in 1915 as Department Bulletin No. 217.

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study. Agents of that bureau also made investigations in the field. In order to determine, if possible, the cause of the mortality, a short preliminary examination of the affected areas was made in August, 1913, by an assistant from the Biological Survey, and in the following year work was begun in July and continued during the summer and fall of 1915 and 1916. A preliminary report covering the work of the first year was published in the spring of 1915.[1] The present bulletin covers the entire investigation in so far as is pertinent to a discussion of the conclusions reached.

HISTORY IN UTAH.

Sick ducks had been noticed in the Bear River marshes at the northern end of Great Salt Lake for many years, though the trouble is not known to have been serious until 1910. The fact that there were sick ducks previous to the severe outbreak in that year was not generally known, some overlooking it and others refusing to admit it. It is well established, however, that sick birds were present in small numbers. Several hunters and guides who have shot on these marshes for many hunting seasons have recalled that sick and dead birds were found at an early day. Twenty-five years ago the hunting season began on September 1, and in certain areas, as in the region known as the North Shore, it was not unusual to find many dead ducks on this date. Occasionally, sick birds were found, and in some cases the rushes were full of decaying bodies. These, however, apparently attracted little attention. Some of the early settlers in this region have reported sick birds at earlier dates.

A few ducks are known to have died on the New State Gun Club grounds at the mouth of the Jordan River in 1902 or 1903, and sick birds were first reported from the mouth of the Weber River at about the same time. Helpless teal, found on several occasions during 1904 in the tules on the Weber River marshes, near the North Shore Gun Club, caused comment among the hunters. There are no records of sick birds during the next four years, but in the summer of 1909 a few were found in the Jordan River marshes, and late in fall others were reported. These late fall birds, found when ice was closing the marshes, may have been affected with some other trouble. Many hunters considered them to be cripples that had escaped during the shooting season. It is said that a considerable number of sick birds were found during that summer on the Weber.

It was not until 1910 that attention was definitely directed to the duck sickness. The summer season of that year was dry and the water level of the rivers far below normal. In mid-July reports were current of a peculiar disease among wild ducks in the marshes

[1] Wetmore, Alex., Mortality among Waterfowl around Great Salt Lake, Utah; U. S. Dept. Agr. Bul. 217, pp. 1–10, pls. 3, 1915.

at the mouth of the Jordan River. As August passed the reports became more numerous, and later a few sick birds were noted at the mouth of the Weber. On September 5 about 50 ducks, dead or helpless, were noticed in the Bear River marshes by A. P. Bigelow, of Ogden, and within a week hundreds were found. At the same time the trouble increased in the other localities mentioned. Many thousand wild ducks died on both the Jordan and the Weber, while on the great mud flats in the Bear River delta the mortality is said to have been almost beyond belief. Dead birds rotting in the sun dotted the water in the shallow bays, and long windrows of bodies were blown up on the shore lines and against the rushes. The birds died in such great numbers, and the causes of the mortality were so obscure, that a strong prejudice arose against killing and eating ducks that were apparently healthy. The gun clubs in the Bear River area were not opened that year, and few ducks were killed elsewhere. Many persons were even afraid to be near or to handle the sick birds, and stories were told of people and domestic animals that had contracted disease through contact with the ducks. Large numbers of dead ducks were picked up by men hired for the purpose on the New State Gun Club grounds during this season. The birds were piled up in heaps and covered with lime, and many of these piles were still intact the following spring. With fall rains and a rise in the rivers, due to the turning in of the flow used for irrigation during the summer, conditions were ameliorated. A few sick birds were present as late as October 21, but soon all had disappeared.

In the Jordan River district the cause of the mortality was attributed to typhoid or some other obscure infection due to the presence of sewage in the water from the Salt Lake City drainage. In 1911 the sewer was continued beyond the marshes to a dumping ground on the lake front, so that sewage was in a large measure eliminated.

In 1911 the trouble began again late in summer and, while prevalent in the same marsh areas, was much less severe than during the preceeding year. As the sickness was considered infectious or contagious, effort was made to remove or bury all dead ducks lying in the water in the channels of the Weber River.

In 1912 conditions were more serious. The marshes about the New State Gun Club are supplied with water through a series of canals, and this year the water was diverted early in the season, so that the marshes were dry, driving out the birds; consequently few died here. The grounds were not flooded again until September 20, when preparation was made for the fall shooting. On both the Weber and Bear River marshes, however, conditions were bad, and attempts were made to clear the marshes of dead birds. W. O. Belnap states that about 30,000 birds were picked up on the Weber River flats, while on Bear River, from records kept by V. F. Davis, it is learned

that the bodies of 44,462 wild ducks were gathered and buried between August 22 and September 21.

In 1913 a few sick birds were noted in the Bear River marshes early in summer, but the trouble was not serious until September. On September 4 Joe Cook reported 600 or more dead birds on some recently flooded flats near the mouth of Channel 3. Three days later men were brought down to pick up the dead birds, and the work continued until September 26. In this period V. F. Davis records that 46,723 ducks were buried. Attempt was made to clean up only those birds lying in the open. These formed but a small part, so that the figures given probably represent less than 20 per cent of the birds that actually died. In gathering these birds men traveled over the soft mud of the flats. The dead ducks were speared with pitchforks and thrown into tubs or boats. Where the soil permitted, these bodies were buried in trenches dug for the purpose. Elsewhere they were piled up, covered with rushes, and finally mud was thrown on them. Some of these piles of bodies were still to be seen during the summer of 1916. In both 1912 and 1913 the sickness ceased shortly after the opening of the hunting season. During the first few days of October in those years sick birds were common, and hunters often set out helpless ducks in front of their blinds as decoys for the healthy birds.

In 1914 sick birds first appeared about July 1, and although the trouble developed to a considerable extent, conditions were much better than in any other year since 1910. Comparatively few birds were lost in the Jordan River marshes, but conditions were not so satisfactory on the lower channels of the Weber. On August 21 probably between 8,000 and 10,000 ducks lay dead along the north channel in a distance of 2 miles (Pl. I, fig. 1). At the same time many helpless birds were in the stagnant water, and a large number unable to fly walked off across the flats at near approach. Birds continued to die here until about September 20. On the Bear River marshes two sick birds were found on July 15, and others had been reported earlier. Sick birds were numerous on August 11, and by August 20 the trouble was at its height. The last sick bird for the season was seen on September 27.

In 1915 the Jordan River marshes were drained, and the ducks frequenting them were driven elsewhere. The season proved to be abnormally dry, and practically no water passed the irrigation dams across the rivers after the 1st of July. The broad flats at the mouth of the Weber River were entirely bare and remained so until fall. In the Bear River region North Bay was dry, while only a narrow channel led through South Bay to the lake. The major part of the ducks normally found here were forced to go elsewhere, and conditions were such that there were few sick birds among those that

remained. A few were found when the water rose in the fall, but it was estimated that not more than 500 birds died during the season.

During 1916 practically no sick birds were found on either the Jordan or Weber Rivers. On Bear River the first were noted on July 3, and the trouble was at its height by August 30, with no abatement until September 25. It was practically at an end before October 1, though occasional sick green-winged teal and spoonbills were noted until October 17.

REPORTS FROM OTHER REGIONS.

Around the shores of Owens Lake, Cal., Dr. A. K. Fisher, of the Biological Survey, found many dead eared grebes and shovellers in June, 1891. He estimated the number of dead grebes at 35,000.[1] In November, 1914, the writer found many birds of these same species, with a few individuals of others, dead in this locality. Apparently the cause of death was similar to that producing the duck sickness in Utah. Considerable numbers of grebes and ducks come to Owens Lake in the fall and remain through the winter. The greater part are said to die before the end of February and are cast up along the shore.

Sick ducks have been observed in the Tulare Lake basin for more than 20 years, according to Tipton Matthews, deputy game warden of Kern County. These birds were found around Goose Lake and on the Widgeon Gun Club grounds at Brown's Knolls when the water supply was low in summer. In 1909 sick birds appeared around Soleta Lake; and in 1910 many thousand ducks died on Soleta, Goose, Buena Vista, and Tulare Lakes. Sick birds were found in these areas during the three years following. Frank C. Clark, a special assistant of the California Fish and Game Commission, made an investigation into the sickness at Tulare Lake in the fall of 1913.[2] In 1914 Soleta and Goose Lakes were dry, and no sick birds occurred on Buena Vista Lake, which was filled with fresh water. Tipton Matthews and the writer estimated that in this year at least 15,000 birds, the greater part of which were pintails, had died on Tulare Lake. Long lines of bodies had washed up along low levees on the south shore, and dead birds were scattered across the drying flats or lay along the dikes where they had crawled out of the water. Since 1914 few sick birds have been known here.

From the Lake Malheur region, in Oregon, a malady apparently the same as the duck sickness of Great Salt Lake has been reported, and in 1916 and 1917 sick ducks were reported from Baca Lake, 35 miles south of Malheur Lake.

An outbreak that occurred at Lake Bowdoin, near Malta, Mont., in August and September, 1915, killed large numbers of shorebirds

[1] North American Fauna No. 7, pp. 12–13, 1893.

[2] Cf. Condor, XV, pp. 214–226, 1913.

and many ducks. A few birds were still affected after the 1st of October. Individuals examined at this time had the same malady as the ducks in Utah, but it can not be stated definitely that all had died from this trouble.

Sick birds in large numbers were reported in the Cheyenne Bottoms, near Great Bend, Kans., in 1914 and 1915. From information furnished by Dr. N. P. Sherwood and Dr. B. T. Clawson, of the University of Kansas, it would seem that these may have been suffering from some bacterial affection.

Other reports more or less indefinite have come from other regions in the West.

OUTLINE OF FIELD WORK.

A preliminary examination and study of conditions was begun by the writer in the Salt Lake Valley on July 12, 1914, and continued without interruption until October 30. Conditions on the Bear, Weber, and Jordan Rivers were studied thoroughly, and visits were made to the Willard Spur, Promontory Point at the southern end of the Promontory Range, and Locomotive Springs, a large isolated marsh area on the northern shore line of Great Salt Lake near Kelton. In connection with this work the writer visited the Tulare Lake basin, in California, from November 3 to 11, where he was assisted materially by Tipton Matthews, deputy warden of Kern County, whose services were made available through cooperation of the California Fish and Game Commission. Following this, conditions were studied at Owens Lake, Cal., from November 12 to 14.

In 1915 work was begun in Utah on May 15 and continued until October 25. As the investigations of the previous year had established that the affection was apparently identical in the three large areas involved, it was decided to carry on intensive work in one area and to visit the other regions when necessary. The marshes and shallow bays in the delta of Bear River at the northern end of Great Salt Lake, offered a great expanse in which conditions were varied and in which waterfowl were enormously abundant. A small temporary field laboratory was erected here, and pens and cages for use in experimental work were built as needed (Pl. IV, fig. 2). This year was unusually dry, and large areas were bare which were covered with water under normal conditions. The New State Gun Club marshes were drained by order of the club authorities early in the year and remained dry during the whole summer season. The entire volume of water in the lower part of the Weber River was taken out for irrigation, and the flats at its mouth were dry until fall. On Bear River the amount of water in the stream was greatly reduced, and large marsh areas, normally covered with from 1 to 10 inches of water, dried and baked in the sun. North Bay was dry, but a part of South Bay remained, and here many ducks congregated. Work was carried

on in the Bear River region until October 28. Lake Bowdoin, near Malta, Mont., where sick ducks had been reported, was visited from October 2 to 9. On August 25 the lakes and marshes west of Salt Lake City were inspected in company with J. C. Smith, of the State Fish and Game Commission. In October one visit was made to Promontory Point.

In 1916 the field laboratory on Bear River was opened on May 15. Experimental work begun in the previous years was carried on to completion, and a large number of birds were handled and studied. The Locomotive Springs marsh near Kelton was visited on August 29. Work terminated on Bear River on October 25.

Acknowledgments are due many organizations and individuals for kindly assistance rendered in many ways, without which the investigation could not have proceeded nor could much valuable information have been secured.[1] The Bureau of Chemistry has cooperated in making analyses of water, alkaline scale, and other material.

THE DUCK SICKNESS.

SYMPTOMS AND DESCRIPTION.

The symptoms of the duck sickness in large part indicate a paralysis of the nerve centers controlling the muscular system. In exercising their powers of flight birds exert a maximum amount of energy, and a decrease in these activities is one of the early indications of the duck sickness. Birds affected may be able to support themselves in the air for short distances only, or may have the wings entirely helpless. Between these two stages all intermediate conditions are found. The paralysis is most marked at first in the great pectoral muscles that direct the wing in its downward stroke. The smaller muscles that support the wing when folded also relax and allow the carpal joint to drop from its normal position, so that the wings in birds at rest droop from the sides of the body (Pl. II, fig. 2). In swimming the anterior wing joint drags in the water, often forcing the wing tips up conspicuously at an angle above the back.

With this affection of the wings the paralysis gradually spreads to the muscles of the legs. Birds become unable to support the body, though still able to swim. Some individuals, though apparently helpless, are able to make off at a great rate by aid of both wings and legs. In individuals of species that have the legs greatly developed and specialized, as the avocet and the black-necked stilt,

[1] Especial thanks are due to the officers of the Duckville Gun Club for living quarters in the clubhouse and to individual members for assistance in field work; to the Bear River Club for permission to use a tract of ground utilized in experimental work, and other facilities; to A. P. Bigelow, of Ogden, Secretary of the Bear River Club Co., for aid in many ways; to L. B. McCornick for valuable assistance; to V. F. Davis, superintendent of grounds of the Bear River Club, for information of value; to Clarence Adney, of Corinne, for assistance; to W. O. Belnap for aid in work at the mouth of the Weber River; to the New State Gun Club for quarters while working on the Jordan River marshes; and to the State fish and game commissioner for permits for shooting and handling birds as needed in the work.

these lower extremities become affected almost at once, and the bird sits on the full length of the tarsus instead of standing on the toes. These birds are unable to escape when approached, but struggle with beating wings to rise to a standing position. In a short time they sink on the breast in the mud and then are entirely helpless. In ducks and most other species, except the shorebirds just mentioned, the legs become affected more gradually. Individual ducks are able to swim for some time after they are unable to support the body in a standing position. Slowly the muscles become more helpless until, capable of slight movement only, the feet remain in normal position under the abdomen. Sick birds seem to sense this increasing helplessness, and, when able, endeavor to work their way out of the water on mud bars, or seek shelter, if available, in rushes or other aquatic growth.

In the next stage of the sickness the neck muscles weaken and the head is supported with difficulty (Pl. II, fig. 1). Birds remain quiet unless frightened, and when disturbed the head, with slight control, sways drunkenly from side to side. Finally the bird lies, unable to move, with the head prone on one side (Pl. III, fig. 1). At this point, if the individual is in water, death comes by drowning, but on land the bird may live for some time longer. Many, however, avert drowning by throwing the head on the back, where it lies in an unnatural position.

Affected individuals early show considerable difficulty in breathing, and as the trouble progresses this is more acute. Inspiration becomes increasingly difficult and may be spasmodic, while the number of respirations per minute is lessened. In a great majority of cases death comes from cessation of breathing due to paralysis of the muscles controlling this function. In some birds the muscles slowly become passive, until finally only those in the anterior thoracic region respond. The intake and outflow of air is slight, and on casual observation such birds might be considered dead.

In severe cases the heart also is affected. Normally the pulse in a wild duck at rest and not unduly excited averages 120 beats per minute. With any struggling or attempt at flight it jumps at once to 180 or 200. In some severe cases of the duck sickness the heart action was weak and irregular. One mallard lived in the laboratory for two days with the heart beating only 30 times each minute and the respirations reduced to 8 for the same period. The body temperature (rectal) in sick birds remains about normal unless the heart is affected. With a decrease in the circulation the temperature falls slowly from the normal register of 104° F. to 109.8° F. (mean, 106.7°) to less than 100° F.

One important external symptom, easily overlooked, remains to be mentioned. Besides upper and lower eyelids birds possess a third

B15723

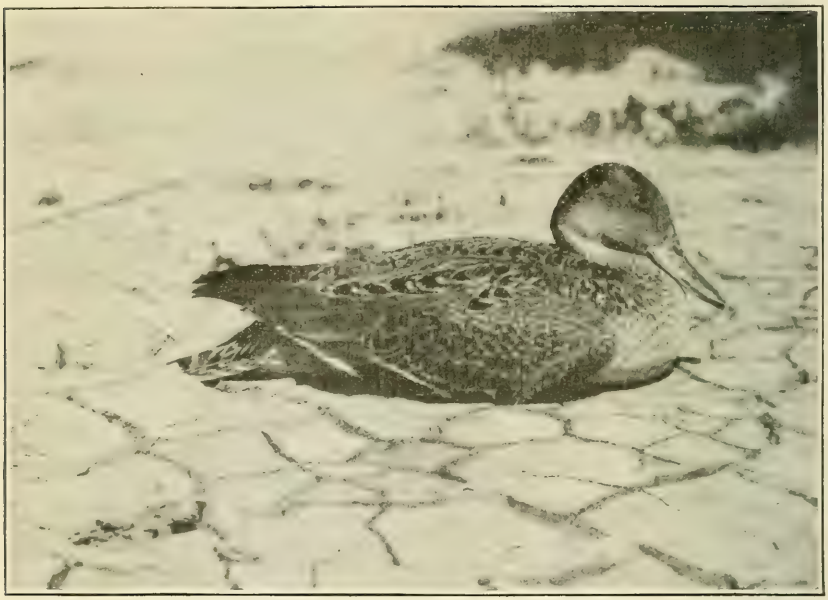
FIG. 1.—DUCKS DEAD FROM THE DUCK SICKNESS.

Photograph taken on the North Channel at the mouth of the Weber River, Utah.

B15730

FIG. 2.—VIEW OF DRYING MUD FLATS AT THE MOUTH OF BEAR RIVER, UTAH.

Ducks are made sick here by alkalis taken into solution when these areas are flooded by rising or shifting water.



B16261

FIG. 1.—PINTAIL WITH THE DUCK SICKNESS.

The eyes are affected, and the bird has difficulty in supporting the head.

B17114

FIG. 2.—CINNAMON TEAL UNABLE TO STAND.

The lower mandible hangs loosely and the wings droop from the sides.

B17111

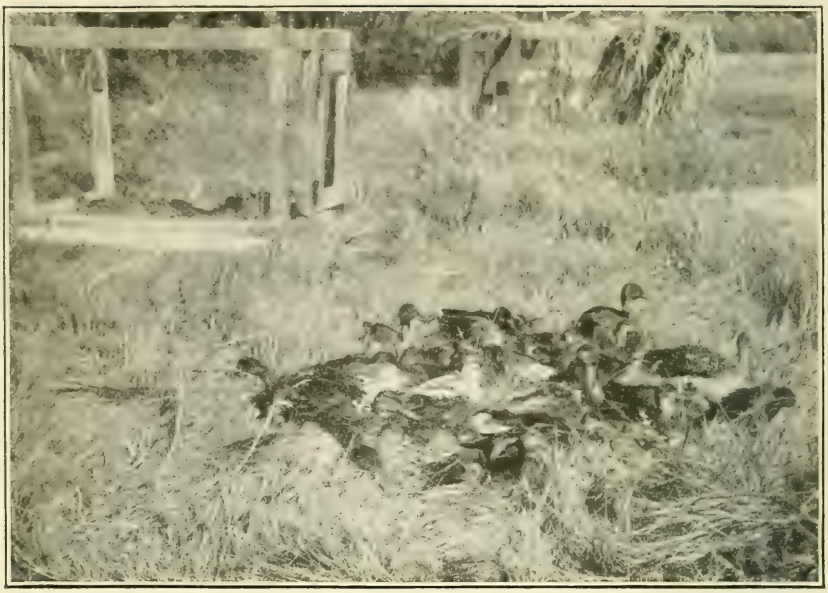
FIG. 1.—SICK MALLARD.

This bird was entirely helpless, but recovered under treatment.

B17123

FIG. 2.—GREEN-WINGED TEAL.

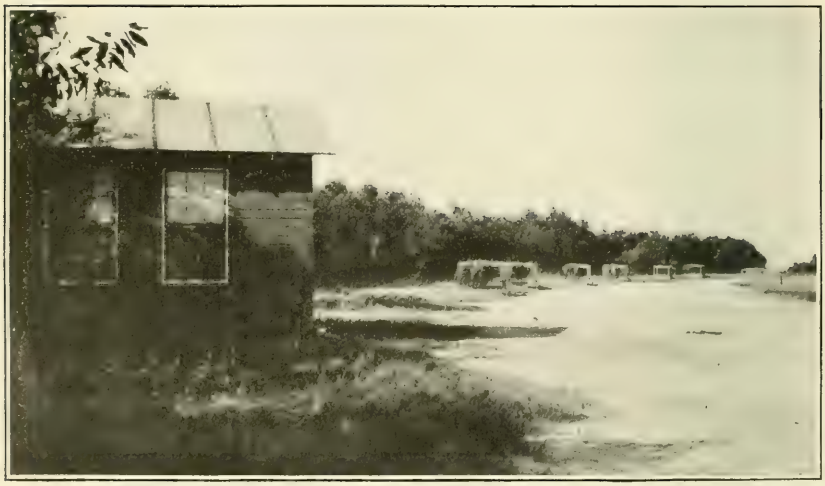
This figure illustrates a method of tying the wings of more active birds to prevent escape during handling.



B17146

FIG. 1.—GROUP OF SICK BIRDS.

These birds were collected on the Bear River Flats and now await transfer to pens.



B16234

FIG. 2.—ROW OF EXPERIMENT PENS AT MOUTH OF BEAR RIVER, UTAH.

The building is a temporary structure erected as a field laboratory. Other experiment pens in use at this time are not shown in the photograph.

eyelid, or nictitating membrane, that lies concealed at the lower angle of the anterior corner of the eye. In winking, this membrane is drawn rapidly back across the eyeball to the posterior corner. In birds with the duck sickness paralysis early affects the muscle (the pyramidalis) controlling this third eyelid, so that its action is more or less weakened. Winking is very slow at first, then the nictitating membrane can come back only part way across the rounded eyeball. Gradually the action of the muscle lessens, until finally the third lid lies motionless in its normal position at the anterior canthus of the eye. To test the activity of this membrane it is necessary only to hold the bird's head firmly and then with some slender object, as a bit of grass stem, a toothpick, the handle of a scalpel, or a pair of tweezers, to touch gently the eyeball near the posterior corner and observe the action of the third lid. When this is unaffected it will spring back at once, perhaps several times, in an effort to protect the sensitive surface of the eyeball. In birds with the duck sickness it operates as has just been described. This one reaction serves as a ready means of distinguishing the duck sickness from any other diseased condition of waterfowl known to the writer.

In connection with the symptom just described is another of interest. Lying within the orbit on the anterior surface of the eyeball is a large gland, known as the Harderian gland. This secretes a fluid that reaches the eyeball at its anterior corner below the nictitating membrane. In the duck sickness this gland always seems more or less affected and in most cases is considerably swollen, so much so, in fact, that the eyes are protuberant. Following this swelling the discharge of colorless, watery fluid from the gland becomes more copious. Normally it escapes at the anterior corner of the eye through two canals that unite and lead into the nasal chamber. In sick birds the secretion becomes greatly augmented, however, until these openings are not able to care for it, the eyes appear watery, and the fluid escapes between the lids. In some pintails kept under observation the escape of this fluid moistened the feathers of the entire side of the head. In a few hours this discharge becomes viscous and more or less opaque, and cements together the eyelids, while the augmenting supply held within puffs out the lids all around. The portion that escapes through the ducts passes through the inner nasal openings into the mouth. As the opening into the trachea (the glottis) lies immediately below, the fluid clogs it and interferes greatly with breathing. After two or three days the secretion becomes caked and cheeselike. When it thickens in large quantity it sometimes closes the trachea and causes strangulation. In a few cases the fluid penetrated to the bronchi, filling them completely and killing the bird. A severe irritation of the mucous membranes of the eye, including the nictitating membrane, is coupled with this discharge. In one case

died in far greater numbers than any of the others; the green-winged teal seemed to have the least resistance, and the pintail was a close second; while mallards, spoonbills, and cinnamon teal died in smaller numbers. The redhead was the only member of the group of deep-water ducks that suffered to any extent, though ruddy ducks were found dead occasionally. Sick gadwalls and widgeons were seldom found. Among the great group of shorebirds, avocets and stilts perished in great numbers, but only occasional individuals of other species were found. In some years the avocets on the Bear River marshes were almost exterminated. In 1915 a great number of immature snowy herons perished, and annually a number of sick white-faced glossy ibises were observed. California and ring-billed gulls were common among the sufferers, and many sick and dead coots were found. Land birds were found sick only occasionally.

The trouble was not entirely restricted to birds, as occasionally muskrats were affected, and frogs (*Rana pipiens*) that apparently had died from this cause were found at times. On Tulare Lake great numbers of predacious diving beetles (*Cybister* sp.) were cast up with the dead birds. Other large beetles (*Dytiscus* sp.) of the same family were found dead or in a more or less helpless condition several times in the Utah marshes. Circumstantial evidence might indicate that these were affected as were the other animals.

In all, 36 species of birds were found that unquestionably had contracted the so-called duck sickness. Thirty-five are listed on field observations made by the writer, and one, the horned lark, is included on the authority of W. H. Meal, of Ogden. Sixteen other species of birds were found under such conditions as to indicate that they had died from the same trouble. The following list, arranged in systematic order, includes only those known certainly to have been affected:

Western grebe (*Æchmophorus occidentalis*).
Eared grebe (*Colymbus n. californicus*).
California gull (*Larus californicus*).
Ring-billed gull (*Larus delawarensis*).
Forster tern (*Sterna forsteri*).
Black tern (*Hydrochelidon n. surinamensis*).
White pelican (*Pelecanus erythrorhynchos*).
Mallard (*Anas platyrhyncha*).
Gadwall (*Chaulelasmus streperus*).
Widgeon (*Mareca americana*).
Green-winged teal (*Nettion carolinense*).
Cinnamon teal (*Querquedula cyanoptera*).
Spoonbill, or shoveller (*Spatula clypeata*).
Pintail (*Dafila a. tzitzihoa*).
Redhead (*Marila americana*).
Ruddy duck (*Erismatura jamaicensis*).
Canada goose (*Branta canadensis*).
White-faced glossy ibis (*Plegadis guarauna*).
Snowy heron (*Egretta t. thula*).
Coot (*Fulica americana*).
Avocet (*Recurvirostra americana*).
Black-necked stilt (*Himantopus mexicanus*).
Long-billed dowitcher (*Macrorhamphus g. scolopaceus*).
Pectoral sandpiper (*Pisobia maculata*).
Least sandpiper (*Pisobia minutilla*).
Red-backed sandpiper (*Pelidna a. pacifica*).[1]
Western sandpiper (*Ereunetes mauri*).
Marbled godwit (*Limosa fedoa*).
Lesser yellow-legs (*Iliornis flavipes*).
Killdeer (*Oxyechus vociferus*).
Horned lark (*Otocoris alpestris* subsp.).
Magpie (*Pica p. hudsonia*).
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*).
Rusty blackbird (*Euphagus carolinus*).[2]
Cliff swallow (*Petrochelidon l. lunifrons*).
Pipit (*Anthus s. rubescens*).

[1] Found at Tulare Lake, Cal.

[2] Found at Lake Bowdoin, Mont.

UNTENABLE THEORIES ADVANCED.

Interest in the duck sickness has been so great among sportsmen and others that many theories as to its cause have been propounded. One of the first and most important attributed it to a disease of bacterial or protozoan origin. A few birds examined early in the outbreak revealed many coccidia, and for a time these were considered the causative agents of the disease. Later investigations, however, did not support this, and all efforts to find and isolate an organism capable of transmitting the trouble from one bird to another failed. For a brief account of the investigations made by the Bureau of Animal Industry the reader is referred to the preliminary report.[1]

Superficially the duck sickness presents many resemblances to avian cholera. Examination of many hundreds of specimens by the writer failed, however, to show any lesions whatever in the viscera (except the irritation in the intestine that has been described). Many blood smears were examined from the peripheral circulation and the heart, with no result. In addition, a large number of experiments were made in attempting to transmit the trouble. Healthy birds were confined with sick birds or were given grain treated freshly with feces taken from affected individuals. Some were fed forcibly on fragments of organs or the entire stomach and intestinal content of sick birds. The mucous lachrymal discharge in birds far gone was transmitted to the eyes of some. Intravenous and hypodermic transfusions of blood were made. All these experiments gave negative results. It has been said that domestic fowls are very susceptible to the duck sickness. Attempts to transmit the trouble to hens were without effect.

During three field seasons many hundreds of wild ducks were kept in confinement. After the nature of the trouble was understood (in 1914) healthy and sick birds were confined in the same pens continually, with no attempt to avoid possible transmission of the trouble, and in no instance did any of the normal birds contract the sickness. Sick birds were handled constantly by the writer and his assistants, but in no case did ducks or other birds tamed and kept as pets around the laboratory contract the trouble. A young great blue heron, reared by hand in 1916, was, with no ill effect, fed often on the flesh of birds that had died from the duck sickness. This same year a considerable number of young wild ducks were reared for use in experiments. Once or twice a week these birds were fed a bran mash containing a quantity of meat. When fresh fish were not available, the bodies of ducks and other birds newly dead from the duck sickness were ground up and fed to them, with no harmful result. If the sickness had been contagious or infectious, cases would have resulted under such treatment.

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[1] U. S Dept. Agr., Bul. 217, p. 5, 1915.

Another theory that attracted much attention was the supposition that the birds were poisoned by sulphurous or sulphuric acid resulting from waste from the great smelters near Salt Lake City. It was believed that sulphur from the smelter smoke, depositing on vegetation, was washed into the streams and marshes by rains, and that in combination with moisture it formed sulphurous and sulphuric acid. It was supposed that the ducks in feeding found this in quantities sufficient to be fatal. It was found, however, that small quantities of these acids, diluted as they must be in nature, had no effect upon ducks, and birds were able to withstand for a considerable period solutions strong enough to be very sour. In these experiments the characteristic appearances and actions of the duck sickness were not produced. Further, the fact that the sick birds are found in the Tulare basin and elsewhere where there are no smelters, and where there is no other appreciable trade waste of sulphur, serves at once to refute this theory.

Many contended that waste water from the settling ponds of the sugar factories was at the bottom of the trouble. This seemed plausible, as sugar factories are located on each of the three rivers in Utah on whose drainage sick ducks occur. Those who supported this theory attributed the affection either to sulphuric acid used in great quantities in the factories and allowed to escape through drains, or to toxic matter from bacterial agencies generated in the catch ponds that receive the factory drainage. The first supposition has been shown to be untenable. As regards the second, the drainage from these ponds enters the rivers in quantity only during the season that the factories operate in fall. By the time this drainage reaches the marshes in abundance few ducks are dying, and finally the mortality ceases while the mills are still in operation. In 1914, drainage from these settling ponds emptying into the Weber came down with the rise in the water level consequent upon the cessation of general irrigation in mid-September, and there was sufficient toxic matter present to kill large numbers of carp and chubs in the lower channels. Many fish-eating birds (all subject to the duck sickness under proper conditions) were attracted by the abundance of fish floating helpless on the water and fed here until these fish disappeared, but no birds were found sick. During late summer many sick ducks had been found along the lower reaches of the Weber where it spreads out on the lake front, but with this rise in the water, conditions among the ducks improved immediately. As in other cases the fact that the duck sickness occurs in areas where there are no sugar factories serves to militate against the theory that toxic matter in factory drainage is the cause.

In addition to these, the trouble has been ascribed variously to the presence of sewage in the water, parasitic nematodes, arsenic poisoning, and other minor hypotheses, none of which has been found tenable.

THE CAUSE.

In the course of the investigations it has been established definitely that the duck sickness in Utah is caused by the toxic action of certain soluble salts found in alkali. In other words, it may be said that it is due to poisoning by alkali, as that term is used in the West. By actual experiment it has been found that the duck sickness may be caused by the chlorides of calcium and magnesium. Experiments have indicated that other salts may be incriminated in Utah and elsewhere, but this statement is made with reserve, as it has not yet been definitely established.

The Salt Lake Valley is well cultivated and productive and owes its fertility almost entirely to irrigation. In the last 15 years the amount of arable land actually under water has greatly increased, and the stream flow at the river mouths has correspondingly decreased. In midsummer of ordinary years little or no water now passes the irrigation dams on Bear River. The water found at that season in the lower channels comes from such small tributaries as enter below the dams and from seepage from water used in irrigation. Practically the same condition holds in the other streams that flow into Great Salt Lake. Thus irrigation has decreased the amount of water supplying the marshes on the lake front, and the resulting slow drainage induces stagnation over large areas. After June 15, as the spring waters in Bear River recede, great expanses of mud flat are laid bare in the sun. Surface evaporation and capillary attraction rapidly draw the salts held in solution in the mud to the surface and there concentrate them. As the mud becomes drier these concentrates are visible as a white deposit or scale (efflorescence). This in many cases is exposed only an inch or so above the surrounding water level (Pl. I, fig. 2). In the large bays strong winds bank up the water and blow it in across these drying flats. As it advances it takes rapidly into solution the soluble salts, largely sodium chloride, but containing calcium and magnesium chloride also. This inflow of water carries with it quantities of seeds and myriads of beetles, bugs, and spiders, washed out of crevices and holes in the dried and cracking soil. The ducks come in eagerly to feed on this easily secured food and work rapidly along at the front of the advancing water, each bird hurrying to get his fill. Many individuals in this way secure a sufficient quantity of these poisons to render them helpless. As the water recedes again small pools are left in shallow depressions, and other ducks and shorebirds feeding in these are affected.

When this phenomenon was understood the writer was able in many cases to predict that with certain strong winds sick birds would occur in numbers in certain localities, and after a proper interval to send out and have them brought in to the laboratory. The alkaline deposits at the mouth of the large channel known as Brown's Overflow were specially strong in the chlorides of mag-

nesium and calcium. In September great numbers of ducks gathered in here at the eastern end of North Bay to feed and rest. At intervals heavy north winds drove in the water over large areas of dry flats, and after 10 or 12 hours many sick teal would be found. Following each storm sick birds would be abundant for two or three days. The water in pools left as the wind died down was salt and bitter to the taste. The sick birds lay along the mud bars and in the shallows, while numbers of them came over into the overflow to drink the fresh water coming in from the river. Many hid in growths of cockle-burs and rushes on shore, while the open water was dotted with dead bodies. On September 17, 1914, 150 birds were secured here, all that the boat would hold. On September 9, 1916, a heavy storm from the north covered these flats, and the following day 80 ducks were captured, while more were brought in on the days following.

Rains have the same effect, and as here they are usually accompanied by strong winds, the two are conjoined in this destruction of bird life. With light rains small pools form everywhere on the alkali barrens, while with heavier downpours these pools become shallow lakes, the water of which is strong with salts held in solution. Ducks flock in to feed upon floating seeds and insects and upon the fleshy, succulent saltweeds (*Salicornia, Atriplex,* and others) and are affected as described before.

In the fall of 1916 the opening of the hunting season on October 1 was marked by a storm that lasted three days. Spoonbills and teal in great numbers were flying back inland to feed, and a number of sick individuals were found, though most of the sickness on the bays had ceased several days before. Had the bays not been filled by the great supply of fresh fall water, many more would have been seriously affected, as on returning to rest from their feeding expeditions they would have had to drink only the stagnant summer water already more or less charged with salts.

On the Weber River flats the trouble may come from shifting water that floods the flats on the lake front or from general stagnation. The South Channel at present carries more or less running water all summer save in exceptional years. No sick ducks have been known to occur on it. The North Channel is well drained only when the river is high in spring and fall. Here the water lies in shallow isolated ponds or in long connected reaches. Late in summer, surface evaporation from these water areas is very rapid, and the concentration of the salts held in solution is great. At the mouth of the Jordan River the sickness occurs in areas where the water becomes stagnant. Such areas become more pronounced as the lower portion of the marsh near the lake front is approached.

The great prevalence of the duck sickness beginning with 1910 must be attributed to the lessened supply of water in the streams. Coupled with this, however, must be other factors not wholly understood. It seems probable that changes in the water level of Great Salt Lake may be prominent among these. Through the courtesy of Otis West, of the Engineering Department of the Southern Pacific Railroad, there is available a graph showing oscillations in the lake level between the years 1850 and 1914. This chart shows a steady decline in the water level from 1886 to 1902. From 1902 to the beginning of 1906 the water remained about the same, except for the usual rise and fall that occurs each year. A rapid rise began then, so that the lake at its highest point in 1910 was nearly 8 feet above the minimum in 1905. From 1910 there was at first a slight drop, then the level was more or less stable until 1914. In 1914 and 1915 the water lowered again somewhat.

The soil below the surface in the Bear River marshes is strongly saline, and the ground water permeating it is heavily impregnated with salts. Though water in the lower channels and bays was fairly fresh, a hole 10 to 15 inches deep at the water's edge usually yielded an abundance of strongly saline water. The great rise in the lake water would, in this region of low elevations, cause a corresponding rise in the water table of the soil and bring salines in quantities to the surface or near it, perhaps for a considerable distance inland. Thus poisonous elements might be available in abundance in areas where ducks formerly had fed with impunity. The effect of the rising salts in the soil is readily seen in the great areas in which the rushes have been killed in the lower portions of the marshes that border the lake front. In many places there remain of the former growths merely the bulbs with short projecting stubs, or again the plants may be newly dead.

Ducks may establish a slight immunity to the alkali when they gradually become accustomed to it in diluted amounts. In the spring numbers of sick birds were said to be found in the lower channels on Bear River when the birds returned from the south. This was verified when many bodies were seen on the banks of the overflows in May of 1915 and 1916. These birds must have died during the early spring, otherwise the spring water and the ice would have carried them away. Following this there are practically no sick ducks until the first part of July. If the water rises in May or June a good many young avocets and stilts are killed in the salt pools formed on the flats, and occasionally sick coots or young ducks are found. In May, 1916, there was a curious instance of the way birds seemingly exempt from this trouble may be affected. A large flock of cliff swallows was driven down to the flats about Duckville by a heavy

storm that covered the mountains with snow. After the storm the sun came out warm and bright, and a number of the swallows gathered about the shallow pools on the barren flats. Apparently in play, they were forming mud pellets such as they use in building their nests. The strong alkalis concentrated in this surface mud affected many of these birds severely, so that during the next few days I picked up several swallows about the laboratory unable to fly, and there is no means of telling how many escaped unnoticed in the salt grass. The affection in the cases examined was similar to that found in the ducks.

Though mortality among ducks and other birds ceases when the fall water fills the rivers, yet many birds are still more or less seriously affected. During the hunting seasons in the years 1914 to 1916, inclusive, the writer examined many hundreds of ducks as they were cleaned and prepared for the market in the duck houses at the gun clubs on Bear River. In birds examined during the first week or 10 days there was severe irritation in the intestinal tract in almost every case. After October 10, there was a great influx of migrants from the north. These birds were shot in many cases before they had been long on the marshes, but still many of those examined had the intestine much irritated. In cases of severe affection that do not terminate fatally individual ducks use up their stores of fatty tissues while recovering from the duck sickness and become thin and poor in flesh. When shot in this condition they are culled by the duck pickers as unfit to eat. I was told by men familiar with conditions that many more ducks are thrown out now than previous to 1910. Certain observations made by the writer seem to prove this. In 1916 sick ducks were last found in numbers in the eastern end of North Bay. After the hunting season opened a larger percentage of culls was noticed among the birds killed in this area than elsewhere.

REMEDIAL MEASURES.

Fresh water is the only agency that has been found of value in combating the duck sickness. Birds slightly affected, and even many entirely helpless, recover in almost all cases when given plenty of moderately fresh water to drink. With an abundance of good water in the marshes sick ducks are infrequent, as when the bays are well filled and well drained many birds that become affected recover in a few days. For remedial agencies, therefore, measures must be adopted that tend to supply fresh water or to drive ducks out from areas where they are liable to obtain alkalis in harmful quantity. Three methods of treatment that promise success in dealing with this trouble are concerned with (1) increasing summer water in streams, (2) draining affected areas, and (3) collecting sick birds for treatment. These methods as outlined in the following pages will prove applicable also in areas outside of Utah where birds are subject to the duck sickness.

INCREASE OF SUMMER WATER IN STREAMS.

Though an increase in the midsummer water supply in the marshes would go far to alleviate the mortality among the waterfowl, it is obvious that it is difficult to increase the stream flow in the lower courses of the rivers at this season under present methods of cultivation by irrigation. At the time when relief is needed in the marshes the demand for water in the fields and orchards of the uplands is at its maximum. Water is then at a premium, and it is difficult to find any surplus. Only by storing water higher up, in the mountains, and releasing it when needed, could the proper result be obtained. And were this done there might be trouble in passing this extra supply through the irrigation dams below, especially in seasons when the general supply is scanty. More land is being reclaimed and put under water each year, so that the demands made upon the midsummer flow in the rivers are constantly increasing. On Bear River the increased demand is gradually extending to the lower courses of the stream, as pumping stations are being established to raise the water where it is not possible to draw it out directly through canals. While suggested here, this method of meeting conditions is hardly considered feasible, and under such conditions recourse must be had to other means.

DRAINAGE OF AFFECTED AREAS.

Areas where the birds may become poisoned are frequently small or local, and some of them, as pools or channels, may be drained with little effort, and in this way opportunity for affection may be removed. This method has been utilized with success in some small areas. In the Jordan River marshes controlled by the New State Gun Club this means of meeting the situation is particularly applicable. The shooting grounds here have been formed artificially in large part by diverting water from the Jordan River through canals and controlling its flow and direction through the channels by means of well-constructed dams, levees, and head gates. The larger part of this marsh may be dried with little difficulty, and this should be done whenever sick ducks appear, in order to drive the birds out to more favorable localities. In general, it will be found that it is necessary to drain the marshes about July 15, though it may be necessary to draw the water from certain pools during June. When the water used in irrigation is returned to the river, usually about September 20, the marshes may again be allowed to fill. Some areas will remain along the lake front where sick birds may occur, but these are small compared with the entire marsh.

Serious objection has been offered to this plan on the ground that it kills off the duck foods in the marsh and that shooting in the fall is poor in consequence. After examining the marshes here it is considered that this objection is not entirely valid. The main food

supply attracting the ducks apparently is found in the seed heads of the tules or rushes and other similar growth found with them that cover great areas. Draining the marshes at this season should not affect these growths, as the water table will not be lowered far enough to deprive them entirely of water. It is true that it will destroy the leaves and plants of the potato moss (*Potamogeton pectinatus*), as this is entirely an aquatic growth. Tubers of this plant will often remain, however, and it is largely upon these that the ducks feed. In normal circumstances, where water stands in the marshes all summer, hunters usually attract the ducks to certain parts of the marsh by baiting with grain.

At the mouth of the Weber River it may be possible to remedy some of the existing conditions by improved drainage. The North Channel in summer is marked by shallow pools with very slight current, while at either side are smaller bodies of water entirely shut off. It is in these that the ducks die. The South Channel has higher banks and runs directly through the flats; in summer it carries drainage from the irrigation canals. As has been stated, no sick ducks are found along its course. Ditching the course of the North Channel and drawing the water from the shallow pools might aid conditions here, as it would leave less of the dangerous area for birds to use.

On Bear River it is not practicable to use these methods of drainage, because the areas involved are too great and because the land is too near the level of the lake to permit concentrating the water in canals.

CURE OF SICK BIRDS.

Birds with the duck sickness recover in a short time (unless too far gone) when placed on water that is moderately fresh. A large number of ducks were cured by this means at the field laboratory on Bear River, and it has been proved that recovery is permanent. In past years men have been employed to gather and bury the dead birds on the marshes. If they were set to work gathering the sick birds and bringing them in, a large number of ducks could be saved at comparatively small expense. This method is one that is strongly recommended for bettering conditions among the waterfowl in severe outbreaks in Utah and elsewhere.

In the course of the present investigation 1,211 individuals belonging to the seven species of ducks most severely affected were treated in this manner. Of these 284 died and 927 recovered. Among the ducks treated were a large number of very weak birds that were so far along that ordinarily they would have been disregarded. Eliminating these, the ratio of recovery was about 90 per cent of those brought in. Table I shows the number and percentage of recoveries and deaths among individuals treated in the seven important species affected.

TABLE I.—*Record of ducks treated.*

Species.	Number treated.	Died.		Recovered.	
		Number.	Per cent.	Number.	Per cent.
Green-winged teal	604	151	25	453	75
Pintail	361	84	23	277	77
Mallard	112	21	19	91	81
Spoonbill	62	13	21	49	79
Cinnamon teal	43	9	21	34	79
Widgeon	15	2	13	13	87
Gadwall	14	4	28	10	72
Total	1,211	284	23	927	77

Green-winged teal show a low percentage of recovery, but this may be explained by the fact that few of those most severely affected recovered. Among mallards and pintails many individuals are killed by lead poison due to eating shot; these have been eliminated from the table. Besides the species enumerated in the table a certain number of redheads are affected, but these seldom recover. This may be attributed to the circumstance that nearly all are young birds that have no reserves of fat to sustain them during the period when they can not feed.

In the three marsh systems in Utah in which birds are affected a small number of men can care for the sick ducks with little trouble. On both the Jordan and Weber River areas artesian water is available. On Bear River recourse must be had to the water in the main river, which, while far from fresh, has proved pure enough for practical use. By experiment it was found that the water served for this purpose in the channels far down toward the bays as long as it was flowing steadily. In fact, many sick birds congregate in the lower parts of the overflows, and there is no question that a large number of these recover naturally.

The sick birds brought in to the laboratory were confined in pens placed at the river's edge, half on land and half in water, where the water at the lower end of the pens was not more than 18 inches deep. These pens were built 6 feet wide, 12 feet long, and 4 feet high. The framework was made of two by fours, save along the bottom, where one by four material was used. An 18-inch door was placed in the shore end. This frame was covered with wire netting on sides, top, and bottom. To confine the larger ducks, 2-inch mesh wire was used. For teal it was found necessary to use wire with 1-inch mesh, as many individuals were able to escape through wire with a larger opening. When the wire resting on shore did not sink in the mud it was covered lightly with salt grass or rushes to give the ducks a comfortable resting place and to protect their feet. Pens of this size are handled by two men without much trouble and may be moved back and forth as the river rises and falls. Larger

and mallards were not far behind in this respect. Some of the birds treated in this way became tame at once, while others seemed never to lose their sense of fear.

Birds vary somewhat in the degree to which they are affected and in the manner in which they recover. A few pintails and green-winged teal handled during 1916 seemed to suffer some breakdown of the nervous system as a result of the severe paralysis. As these individuals recovered from their helpless condition they had little or no control over their muscular movements, though they seemed normal in other ways. There was a constant trembling of the head, and with any attempt at movement head, wings, and feet were thrown about convulsively. As it raised its head in attempting to drink, such a bird might throw itself completely over, or in trying to swim to shore might dash in circles about the pen, turning over and over. Birds affected in this way, however, were comparatively rare. None of those under observation recovered.

Birds that are seriously sick get very thin as they recover, but soon regain their normal flesh. Sick ducks in captivity should be fed morning and evening. The writer used wheat and barley mixed in equal parts as food for the larger ducks. Teal seldom eat anything but wheat. The grain was placed in shallow wooden troughs 5 feet long, from 4 to 6 inches wide, and 1½ to 2 inches deep. These troughs were placed across the pen a foot or so from the edge of the water. In this way the grain was brought to the notice of the birds as they went in and out of the water. In addition to grain it is well to have a small pan of grit in each pen.

During hot weather half of each pen should be covered with rushes in order to protect captive birds from the sun. Though able to endure intense heat when free, birds may succumb when confined in a narrow space unless protected. On Bear River it was necessary to inclose that part of the pens projecting into the water as a protection against the inroads of the numerous carp. Along the river banks in low water during summer a margin of mud is exposed that separates the roots of the riparian vegetation from the water. This deprives the carp of a large part of their natural feeding grounds, so that grain and excrement about the duck pens proved a great attraction to them and they frequently dug out the mud under an entire pen in the course of a night. Racks 6 or 8 feet long were made of lath sharpened at one end and nailed to crosspieces, with half-inch spaces. With these a fence was built in the water 3 feet beyond the pens and the same distance from either end. This permitted free circulation of water and at the same time kept the carp from digging, as the lath were sunk from 6 to 12 inches in the mud. It is necessary to fill in the duck pens from time to time, as the more active ducks continually dig away the mud from the shore.

RELEASE OF BANDED BIRDS.

Aluminum bands were placed on the legs of about 1,000 ducks that were cured and released at the mouth of Bear River. From these banded birds data have been obtained upon the permanency of the cure and the subsequent longevity of individuals that have recovered. The bands used thus far are of two types: Each bears a number stamped upon one side; on the reverse, one is marked "Notify U. S. Dept. Agr., Wash., D. C.;" the other "Notify Biological Survey, Washington, D. C." These bands are light and in addition are little affected by salt or alkaline waters. Returns have come in at the present time from about 170 of these ducks. Many of these were killed locally, but nearly always under circumstances that indicated that they had fully recovered. Others have come from greater distances. Individual records range west to the Pacific Ocean in California, south to the Mexican border in New Mexico, east to Joplin, Mo., and north into southern Saskatchewan in Canada. Three birds banded in 1914 were killed by hunters during 1916, and another released at the same time was reported in 1917, so that there can be no doubt that the birds treated recovered fully.

Valuable information has been obtained from reports on these banded ducks as to the lines of flight pursued by waterfowl during their migrations. This is of the greatest importance, and it is desired that sportsmen or others who chance to kill these banded birds send immediately full details to the Biological Survey as to the number of the band, together with date and place of capture.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 673

Contribution from the Forest Service
HENRY S. GRAVES, Forester

Washington, D. C. PROFESSIONAL PAPER April 19, 1918

PRODUCTION OF LUMBER, LATH, AND SHINGLES IN 1916.

By FRANKLIN H. SMITH and ALBERT H. PIERSON, *Statisticians in Forest Products.*

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INTRODUCTION.

In this bulletin, which is one of an annual series covering the period 1904 to 1916, inclusive, with the exception of 1914, are detailed statistics on the 1916 production of lumber, lath, and shingles. A detailed summary of the 1914 lumber production is given in Bulletin 506, which contains the figures for 1915. Preliminary statements issued in April, 1917, summarized the production statistics for 1916. This bulletin details the 1916 data and presents comparative figures from the annual reports for earlier periods.

NOTE.—Acknowledgment is made for assistance in the compilation and review of this bulletin to R. S. Kellogg, secretary of the National Lumber Manufacturers' Association; A. B. Strough, New York Conservation Commission; and to H. N. Knowlton, Miss Frances R. Waters, Quincy Randles, Miss Maud A. Bell, Asa L. Brower, C. A. Kupfer, H. B. Oakleaf, and C. W. Gould, of the Forest Service.

Compilation of the figures for the Western States was made by the district products offices of the Forest Service at Missoula, Denver, Albuquerque, Ogden, San Francisco, and Portland. Figures for New York State were furnished by the New York Conservation Commission. The work in all of the other States east of the Rocky Mountains was done by the Office of Industrial Investigations of the Forest Service, Washington, D. C.

The entire project was carried on in cooperation with the National Lumber Manufacturers' Association, which not only contributed financially, but, through its affiliated organizations, assisted materially in making the statistics complete.

TOTAL LUMBER PRODUCTION.

The estimated total production of lumber in the United States during 1916 was 40,000,000,000 board feet, or approximately 5 per cent greater than in 1915. The quantity actually reported by 17,269 active mills was 34,791,385,000 board feet.

Production of lumber, particularly the more commonly used building woods, was exceptionally heavy during the spring and early summer, reaching its apex in May. Then followed a severe curtailment, which was carried on into July. From July on production was again increased until a maximum was reached in October, to be followed by the usual decline upon the approach of winter. The output of the sawmills of the country in 1916 was restricted to a considerable degree by an unprecedented shortage of cars, by increased wages and an insufficient supply of labor, and by the largely inflated cost of supplies. Building operations, however, were on a record-creating scale throughout the United States; and this condition was responsible for the heavier production in 1916 than in the previous year, since a proportionately greater quantity of lumber went into domestic consumption than under normal world conditions. Exports of both softwoods and hardwoods were considerably reduced through lack of available tonnage. The production of certain woods was stimulated by world-wide war demands, but on the whole the lumber industry profited little directly by the impetus given many industries in 1916 by the war.

In Table 1 is shown the cut reported each year from 1899 for which data have been compiled, together with the number of active mills reporting. The estimated total cut for each year is also given. The statistics for all of the years are not directly comparable, since the intensiveness of the individual canvass made must be taken into consideration. The enumeration for 1899 and 1909 was practically complete, since the field agents of the Bureau of the Census in carrying on the decennial censuses reached nearly all, if not all, mills.

In other years, as in 1916, the work was conducted almost exclusively by mail. The tabulation shows a reported cut in 1916 almost 4,000,000,000 feet greater than in 1915, but smaller than in any other year since 1908. The estimated cut for 1916 is the smallest for any year shown except 1915.

TABLE 1.—*Quantity of lumber reported, number of active sawmills reporting, and estimated total cut, 1904–1916.*

Year.	Reported cut of lumber.	Number of active mills reporting.	Estimated total cut of lumber.
	Board feet.		*Board feet.*
1899	35,084,166,000	31,833	35,084,166,000
1904[1]	34,135,139,000	[2] 18,277	43,000,000,000
1905	30,502,961,000	11,666	43,500,000,000
1906	37,550,736,000	22,398	46,000,000,000
1907[3]	40,256,154,000	28,850	46,000,000,000
1908[3]	33,224,369,000	31,231	42,000,000,000
1909	44,509,761,000	[4] 46,584	.....
1910[3]	40,018,282,000	[2] 31,934	44,500,000,000
1911[3]	37,003,207,000	[2] 28,107	43,000,000,000
1912	39,158,414,000	[2] 29,005	45,000,000,000
1913	38,387,009,000	[2] 21,668	44,000,000,000
1914[1]	37,346,023,000	[2] 27,506	40,500,000,000
1915	31,241,734,000	[2] 16,815	38,000,000,000
1916	34,791,385,000	[2] 17,269	40,000,000,000

[1] Custom mills excluded.
[2] Mills cutting under 50,000 feet excluded.
[3] Including mills which manufacture lath and shingles exclusively (1,500 estimated).
[4] Includes 4,543 mills cutting less than 50,000 feet, and all cooperage, veneer, millwork, box, furniture, and other factories cutting any lumber at all in 1909.

LUMBER PRODUCTION BY CLASSES OF MILLS.

As in previous years, the mills were arbitrarily divided into classes according to the quantity reported cut. These classes are shown in Table 2, with the computed[1] number of mills and production (p. —) and with comparative data for other years.

The figures in Table 2 indicate the relation between the mill classes and production, and this feature is emphasized in figure 1 (p. 4). It is especially significant that 925 mills, or 3.08 per cent of the number computed as operating, cut more than 23,000,000,000 feet, or 58.56 per cent of the computed total production. The smaller mills—21,037 operations—constituting 69.93 per cent of the computed number, cut but 4,027,912,000 feet, or 10.12 per cent of the total output of all the mills.

All of the mills which reported for 1916 have been classified according to production and further arranged by States in Table 3 (p. —). The tabulation well illustrates the extended character of the lumber manufacturing industry and at the same time shows the concentration of large units in a few States in the principal producing

[1] "Computed" is used in this bulletin to characterize results which were obtained by an extension of the figures compiled from actual reports, so as to give the totals for approximately all mills, including those from which no reports were received.

regions. For instance, of the mills reporting a cut of 10,000,000 feet or more in the South, 121 were located in Louisiana, 70 in Mississippi, 59 in Texas, 31 in Alabama, and 38 in Arkansas; in the West 126 were in Washington, 62 in Oregon, and 36 in California and Nevada; and the Lake States were represented by 23 in Minnesota, 35 in Michigan, and 49 in Wisconsin.

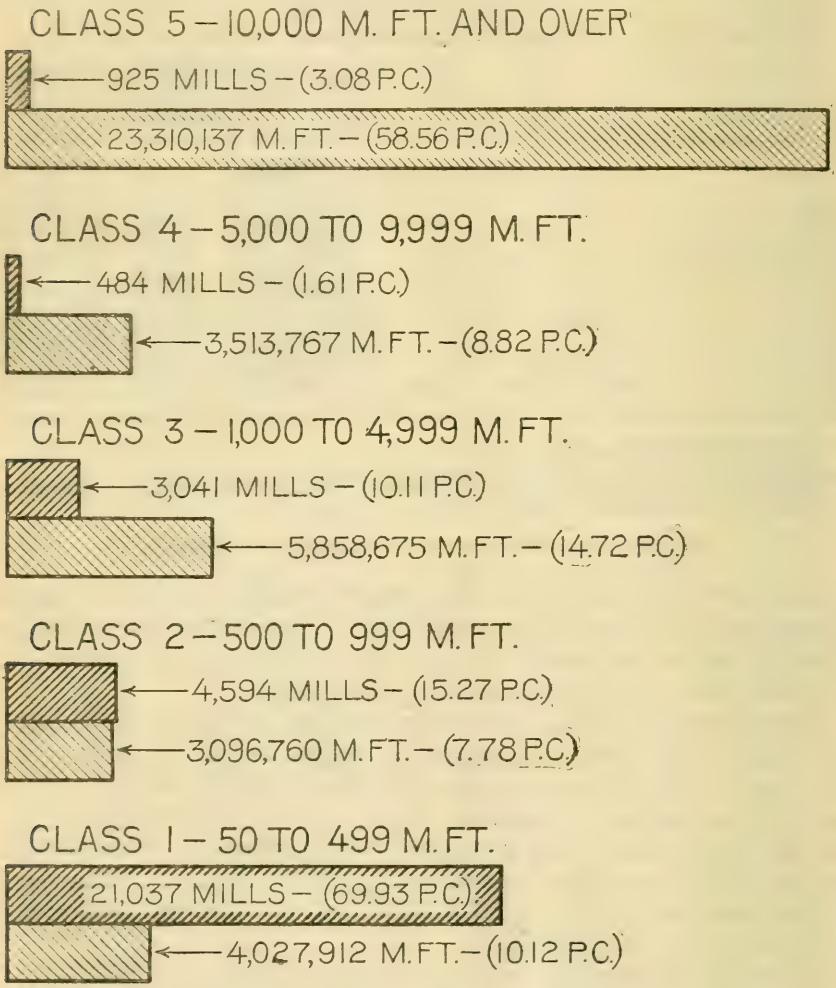

FIG. 1.—Relation between the mill classes and production in 1916.

The character of the timber and the concentration of the supply in the several regions are reflected in the number and size of the mills operating in the different States. Further, it is noticeable that as the timber in the older lumbering regions is depleted the larger operations give way to the smaller outfits. New York, with more than 1,100 mills, has the greatest number of class 1 mills operating

and an additional 624 mills cutting less than 50,000 feet of lumber each. North Carolina, Virginia, and Pennsylvania also have a large number of mills which fall into class 1.

Since no vast bodies of unexploited timber remain to be opened up, the relative importance of the producing regions is likely to continue unchanged for several years.

TABLE 2.—*Reported production of lumber 1909, 1912, 1913, 1914, and computed totals 1915 and 1916, by classes of mills.*

Classes.	Mills.			Quantity reported.	
	Year.	Number reporting.	Per cent.	Feet B. M.	Per cent.
All classes	[1] 1909	42,041	100.00	44,384,795,000	100.00
	1912	29,005	100.00	39,158,414,000	100.00
	1913	21,668	100.00	38,387,009,000	100.00
	1914	27,506	100.00	37,346,023,000	100.00
	[2] 1915	29,951	100.00	37,011,656,000	100.00
	[2] 1916	30,081	100.00	39,807,251,000	100.00
Class 5—10,000,000 feet and over per year	1909	888	2.11	19,126,223,000	43.09
	1912	926	3.19	21,259,274,000	54.29
	1913	974	4.50	23,211,667,000	60.47
	1914	867	3.15	20,934,446,000	56.06
	[2] 1915	846	2.82	20,669,746,000	55.84
	[2] 1916	925	3.08	23,310,137,000	58.56
Class 4—5,000,000 to 9,999,000 feet per year	1909	783	1.86	5,291,606,000	11.92
	1912	608	2.10	4,311,063,000	11.01
	1913	740	3.41	4,303,122,000	11.21
	1914	547	1.99	3,910,370,000	10.47
	[2] 1915	453	1.51	3,224,448,000	8.71
	[2] 1916	484	1.61	3,513,767,000	8.82
Class 3—1,000,000 to 4,999,000 feet per year	1909	5,443	12.95	10,068,592,000	22.69
	1912	3,747	12.92	7,009,608,000	17.90
	1913	3,265	15.07	6,319,753,000	16.46
	1914	3,291	11.97	6,078,730,000	16.28
	[2] 1915	3,191	10.65	6,201,864,000	16.76
	[2] 1916	3,041	10.11	5,858,675,000	14.72
Class 2—500,000 to 999,000 feet per year	1909	6,468	15.39	4,315,636,000	9.72
	1912	4,420	15.24	2,951,068,000	7.54
	1913	3,148	14.53	2,049,642,000	5.34
	1914	4,261	15.49	2,780,184,000	7.44
	[2] 1915	4,198	14.02	2,941,264,000	7.95
	[2] 1916	4,594	15.27	3,096,760,000	7.78
Class 1—50,000 to 499,000 feet per year	1909	28,459	67.69	5,582,738,000	12.58
	1912	19,304	66.55	3,627,401,000	9.26
	1913	13,541	62.49	2,502,825,000	6.52
	1914	18,540	67.40	3,642,293,000	9.75
	[2] 1915	21,263	70.99	3,974,334,000	10.74
	[2] 1916	21,037	69.93	4,027,912,000	10.12

[1] The total for 1909 differs from that shown in other tables because 4,543 mills cutting 124,966,000 feet, or less than 50,000 feet each, are omitted above.
[2] The data here shown for both 1915 and 1916 are computed totals by classes of mills.

TABLE 3.—*Sawmills classified according to quantity of lumber cut, by States, 1916.*

	Aggregate.		Class 5.—Mills cutting over 10,000,000 feet.		Class 4.—Mills cutting from 5,000,000 to 9,999,000 feet.		Class 3.—Mills cutting from 1,000,000 to 4,999,000 feet.		Class 2.—Mills cutting from 500,000 to 999,000 feet.		Class 1.—Mills cutting from 50,000 to 499,000 feet.	
	Number of active mills reporting.	Quantity.	Number of mills.	Quantity.	Number of mills.	Quantity.	Number of mills.	Quantity.	Number of mills.	Quantity.	Number of mills.	Quantity.
		Feet b. m.		*Feet b. m.*		*Feet b. m.*		*Feet b. m.*		*Feet b. m.*		*Feet b. m.*
United States	17,269	34,791,385,000	907	23,011,296,000	464	3,365,902,000	2,363	4,575,926,000	2,577	1,736,787,000	10,958	2,101,474,000
Alabama	744	1,310,653,000	31	616,143,000	27	189,165,000	165	365,309,000	102	67,187,000	419	72,849,000
Arizona	17	92,872,000	4	88,870,000					2		11	[1] 4,002,000
Arkansas	706	1,668,493,000	38	1,011,483,000	37	267,958,000	116	238,734,000	106	73,173,000	409	77,145,000
California and Nevada	182	1,413,541,000	36	1,212,969,000	16	115,167,000	20	50,288,000	27	18,352,000	83	16,765,000
Colorado	96	67,368,000			2		20	[2] 51,283,000	7	4,361,000	67	11,724,000
Connecticut	145	60,163,000					17	21,522,000	30	21,648,000	98	16,993,000
Delaware	34	9,356,000							7	3,735,000	27	5,621,000
Florida	225	1,179,717,000	43	860,829,000	22	163,899,000	46	112,760,000	39	26,825,000	75	15,404,000
Georgia	710	753,930,000	13	219,513,000	21	153,446,000	115	208,929,000	139	89,661,000	422	82,381,000
Idaho	190	846,107,000	23	765,611,000	3	21,079,000	15	25,114,000	17	11,925,000	132	22,378,000
Illinois	114	43,731,000			1		7	[3] 22,432,000	8	5,446,000	98	15,853,000
Indiana	471	209,354,000			1		47	[3] 94,921,000	71	48,253,000	352	66,180,000
Iowa	61	18,027,000			1		1		2	[4] 8,720,000	57	9,307,000
Kansas	5	534,000									5	534,000
Kentucky	597	374,074,000	5	77,918,000	9	65,112,000	41	80,884,000	93	61,509,000	449	88,651,000
Louisiana	329	3,910,866,000	121	3,437,419,000	37	277,447,000	64	153,152,000	45	30,846,000	62	12,002,000
Maine	606	866,749,000	15	264,188,000	19	147,194,000	162	308,764,000	115	78,374,000	295	68,229,000
Maryland	213	68,988,000			1		10	[3] 18,736,000	32	20,478,000	170	29,774,000
Massachusetts	260	176,268,000	1				56	[5] 109,758,000	47	34,300,000	156	32,210,000
Michigan	341	1,019,183,000	35	600,235,000	32	233,562,000	47	118,986,000	42	28,952,000	185	37,448,000
Minnesota	211	1,063,046,000	23	958,340,000	6	44,037,000	12	21,800,000	16	11,879,000	154	26,990,000
Mississippi	627	2,353,891,000	70	1,699,709,000	27	197,208,000	166	342,238,000	92	64,218,000	272	50,518,000
Missouri	389	219,244,000	3	35,842,000	5	38,671,000	38	69,063,000	33	22,194,000	310	53,474,000
Montana	103	383,884,000	8	322,430,000	4	30,199,000	8	12,381,000	10	6,229,000	73	12,645,000
New Hampshire	305	336,064,000	1		2	[5] 39,105,000	112	218,206,000	76	54,467,000	114	24,286,000
New Jersey	109	30,925,000					5	6,752,000	14	9,430,000	90	14,743,000
New Mexico	55	80,406,000	3	42,500,000	1		6	[3] 20,811,000	23	12,942,000	22	4,153,000
New York	1,260	349,908,000	3	35,816,000	2		37	[2] 76,338,000	97	66,357,000	1,121	171,352,000
North Carolina	1,532	1,657,032,000	36	608,915,000	32	220,610,000	226	421,028,000	294	193,269,000	944	213,210,000
Ohio	546	219,042,000	1		2	[5] 27,354,000	32	44,972,000	86	57,041,000	425	89,675,000

Oklahoma	91	232,198,000	6	181,786,000	1		[4] 11	[3] 31,849,000	10	7,277,000	63	11,286,000
Oregon	525	2,221,854,000	62	1,833,853,000	12	84,676,000	99	182,902,000	91	65,264,000	261	55,159,000
Pennsylvania	934	565,895,000	10	233,696,000	4	29,083,000	51	81,205,000	115	76,335,000	754	145,576,000
Rhode Island	19	17,827,000					11	14,722,000	3	2,325,000	5	780,000
South Carolina	443	746,301,000	18	363,159,000	15	115,572,000	101	191,344,000	51	33,096,000	258	43,130,000
South Dakota	27	26,450,000	1				1		3	[6] 22,906,000	22	3,544,000
Tennessee	768	488,242,000	6	86,969,000	14	96,002,000	60	118,055,000	106	72,031,000	582	115,185,000
Texas	301	1,723,826,000	59	1,451,825,000	15	109,403,000	65	110,125,000	43	27,875,000	119	24,598,000
Utah	76	9,383,000							2		74	[1] 9,383,000
Vermont	335	180,234,000	1		2	[5] 28,775,000	39	60,800,000	62	43,101,000	231	47,558,000
Virginia	1,210	1,036,209,000	21	375,793,000	13	92,654,000	152	236,932,000	259	171,363,000	765	159,467,000
Washington	444	4,492,997,000	126	4,003,669,000	33	232,563,000	87	192,646,000	54	36,614,000	144	27,505,000
West Virginia	475	1,009,156,000	35	608,030,000	26	183,634,000	48	110,378,000	67	46,815,000	299	60,299,000
Wisconsin	386	1,240,778,000	49	925,218,000	19	143,599,000	45	100,212,000	38	24,886,000	235	46,863,000
Wyoming	52	16,619,000					2		1	[7] 9,342,000	49	7,277,000

[1] Includes the cut of 2 mills in class 2.
[2] Includes the cut of 2 mills in class 4.
[3] Includes the cut of 1 mill in class 4.
[4] Includes the cut of 1 mill each in classes 4 and 3.
[5] Includes the cut of 1 mill in class 5.
[6] Includes the cut of 1 mill each in classes 5 and 3.
[7] Includes the cut of 2 mills in class 3.

CUT AND CAPACITY OF REPORTING MILLS.

For the purpose of determining within a reasonable degree of accuracy the relation of the cut to capacity of the mills of the country, data was asked of the mills as to the quantity of lumber that could be cut if the price and demand were very favorable. More than one-half of the total number of mills which reported furnished figures on capacity, and these figures are compiled in Table 4 below. The computations bear out the generally accepted statement that the larger the plant the nearer to capacity it is operated. The figures themselves show that the class 5 mills reporting ran to approximately 71 per cent of capacity, class 4 mills to 64 per cent, class 3 mills to 50 per cent, class 2 mills to 34 per cent, and class 1 mills to but 17 per cent. The aggregate quantity reported cut by the mills making returns as to capacity was approximately 55 per cent of the capacity of the mills as a whole. It should be taken into consideration that much speculation must necessarily enter into the individual calculation as to quantity of lumber which could be produced economically; and that each case would be modified by varying factors, such as capital, log supply, equipment, labor, markets, and shipping facilities.

TABLE 4.—*Reported cut and capacity of reporting mills.*

	Cut of mills reporting capacity.	Number of mills reporting capacity.	Capacity reported.	Total mills.	Total cut.
	Feet b. m.		*Feet b. m.*		*Feet b. m.*
Total	20,847,608,000	9,566	37,942,157,000	17,269	34,791,385,000
Class 5	14,271,909,000	540	20,052,040,000	907	23,011,296,000
Class 4	1,825,068,000	251	2,868,515,000	464	3,365,902,000
Class 3	2,561,037,000	1,321	5,155,422,000	2,363	4,575,926,000
Class 2	1,006,886,000	1,491	2,969,126,000	2,577	1,736,787,000
Class 1	1,182,708,000	5,963	6,897,054,000	10,958	2,101,474,000

LUMBER PRODUCTION BY STATES.

The growth and decline of lumber production in the several States is traceable in Table 5 (p. 9–11), which details by States for 12 calendar years the total number of active sawmills reporting and the quantity of lumber reported sawed. The accuracy of the 1915 and 1916 figures is comparatively greater for the Western States than for the Eastern States, since the district offices of the Forest Service are in more intimate touch with the mills than it is practicable for the Washington office to be with the larger number of mills east of the Rocky Mountains. More reliable computed figures can also be given for the West.

The tabulation not only permits of a comparison by years for each State, but records the results of events which have served either to retard or accelerate the production of lumber in a State or group of States. For Washington is shown a cut in 1916 that is three times as great as the 1899 cut. Louisiana's mill output has been all but

quadrupled in the same period. Many of the other States have increased their production during the last decade, including Mississippi, Oregon, North Carolina, Alabama, and Florida. Conversely, production in 1916 shows a decline from that of 1907 in Texas, Wisconsin, Michigan, Minnesota, Arkansas, Virginia, West Virginia, Maine, and Pennsylvania, though the decline is not so great as might be expected under conditions of continued heavy cutting.

TABLE 5.—*Total number of active sawmills reporting and quantity of lumber reported or computed, by States, 1899–1916.*

	1916 (30,081 mills).[1]	1915 (29,951 mills).[1]	1914 (27,506 mills).[2]	1913 (21,668 mills).
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
Total	[3] 39,807,251,000	[3] 37,011,656,000	[3] 37,346,023,000	[3] 38,387,009,000
Washington	4,494,000,000	3,950,000,000	3,946,189,000	4,592,053,000
Louisiana	4,200,000,000	3,900,000,000	3,956,434,000	4,161,560,000
Mississippi	2,730,000,000	2,300,000,000	2,280,966,000	2,610,581,000
Oregon	2,222,000,000	1,690,000,000	1,817,875,000	2,098,367,000
North Carolina	2,100,000,000	2,090,000,000	2,227,854,000	1,957,258,000
Texas	2,100,000,000	1,750,000,000	1,554,005,000	2,081,471,000
Arkansas	1,910,000,000	1,800,000,000	1,796,780,000	1,911,647,000
Alabama	1,720,000,000	1,560,000,000	1,494,732,000	1,523,930,000
Wisconsin	1,300,000,000	1,210,000,000	1,391,001,000	1,493,352,000
Florida	1,425,000,000	1,110,000,000	1,073,821,000	1,055,047,000
California	[4] 1,420,000,000	[4] 1,130,000,000	1,303,183,000	1,183,380,000
Virginia	1,335,000,000	1,500,000,000	1,488,070,000	1,273,953,000
Michigan	1,230,000,000	1,100,000,000	1,214,435,000	1,222,983,000
West Virginia	1,220,000,000	1,100,000,000	1,118,480,000	1,249,559,000
Minnesota	1,220,000,000	1,100,000,000	1,312,230,000	1,149,704,000
Georgia	1,000,000,000	1,000,000,000	1,026,191,000	844,284,000
Maine	935,000,000	1,000,000,000	992,594,000	834,673,000
South Carolina	857,000,000	800,000,000	701,540,000	752,184,000
Idaho	849,600,000	777,000,000	763,508,000	652,616,000
Pennsylvania	750,000,000	950,000,000	864,710,000	781,547,000
Tennessee	700,000,000	800,000,000	885,035,000	872,311,000
Kentucky	525,000,000	560,000,000	596,392,000	541,531,000
New York	400,000,000	475,000,000	486,195,000	457,720,000
New Hampshire	385,000,000	500,000,000	482,744,000	399,424,000
Montana	383,900,000	328,000,000	317,842,000	357,974,000
Ohio	280,000,000	400,000,000	283,063,000	414,943,000
Indiana	270,000,000	350,000,000	298,571,000	332,993,000
Missouri	260,000,000	350,000,000	370,571,000	416,608,000
Oklahoma	240,000,000	230,000,000	200,594,000	149,284,000
Massachusetts	210,000,000	250,000,000	143,094,000	224,580,000
Vermont	200,000,000	260,000,000	249,608,000	194,647,000
Arizona	93,270,000	75,915,000	78,667,000	77,363,000
New Mexico	91,600,000	65,787,000	57,167,000	65,818,000
Maryland	90,237,000	165,000,000	162,097,000	140,469,000
Colorado	77,580,000	74,500,000	102,117,000	74,602,000
Connecticut	75,000,000	90,000,000	81,883,000	93,730,000
Illinois	60,000,000	110,000,000	66,227,000	102,902,000
New Jersey	40,000,000	45,000,000	48,748,000	27,248,000
South Dakota	29,650,000	22,552,000	18,744,000	19,103,000
Iowa	20,000,000	35,000,000	11,443,000	21,676,000
Wyoming	18,495,000	17,000,000	11,852,000	12,940,000
Rhode Island	18,000,000	15,000,000	15,992,000	14,984,000
Delaware	12,000,000	25,000,000	25,517,000	18,039,000
Utah	9,385,000	10,892,000	8,680,000	5,403,000
Kansas	534,000	.....	.....	.....
All other States	.....	(5)	[6] 15,672,000	[6] 19,461,000

[1] Figures shown are computed totals.
[2] Custom mills excluded.
[3] Mills cutting less than 50,000 feet per year excluded.
[4] Includes cut of 2 mills in Nevada.
[5] Kansas and Nebraska mills reported less than 50,000 feet each, and these States are therefore omitted.
[6] Includes Kansas, Nebraska, and Nevada.

TABLE 5.—*Total number of active sawmills reporting and quantity of lumber reported or computed, by States, 1899–1916*—Continued.

	1912 (29,005 mills).	1911 (28,107 mills).[1]	1910 (31,934 mills).[1]	1909 (46,584 mills).
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
Total	[2] 39,158,414,000	[2] 37,003,207,000	[2] 40,018,282,000	44,509,761,000
Washington	4,099,775,000	4,064,754,000	4,097,492,000	3,862,916,000
Louisiana	3,876,211,000	3,566,456,000	3,733,900,000	3,551,918,000
Mississippi	2,381,898,000	2,041,615,000	2,122,205,000	2,572,669,000
Oregon	1,916,160,000	1,803,698,000	2,084,633,000	1,898,995,000
North Carolina	2,193,308,000	1,798,724,000	1,824,722,000	2,177,715,000
Texas	1,902,201,000	1,681,080,000	1,884,134,000	2,099,130,000
Arkansas	1,821,811,000	1,777,303,000	1,844,446,000	2,111,300,000
Alabama	1,378,151,000	1,226,212,000	1,465,623,000	1,691,001,000
Wisconsin	1,498,876,000	1,761,986,000	1,891,291,000	2,025,038,000
Florida	1,067,525,000	983,824,000	992,091,000	1,201,734,000
California	1,203,059,000	1,207,561,000	1,254,826,000	1,143,507,000
Virginia	1,569,997,000	1,359,790,000	1,652,192,000	2,101,716,000
Michigan	1,488,827,000	1,466,754,000	1,681,081,000	1,889,724,000
West Virginia	1,318,732,000	1,387,786,000	1,376,737,000	1,472,942,000
Minnesota	1,436,726,000	1,485,015,000	1,457,734,000	1,561,508,000
Georgia	941,291,000	801,611,000	1,041,617,000	1,342,249,000
Maine	882,128,000	828,417,000	860,273,000	1,111,565,000
South Carolina	816,930,000	584,872,000	706,831,000	897,660,000
Idaho	713,575,000	765,670,000	745,984,000	645,800,000
Pennsylvania	992,180,000	1,048,606,000	1,241,199,000	1,462,771,000
Tennessee	932,572,000	914,579,000	1,016,475,000	1,223,849,000
Kentucky	641,296,000	632,415,000	753,556,000	860,712,000
New York	502,351,000	526,283,000	506,074,000	681,440,000
New Hampshire	479,499,000	388,619,000	443,907,000	649,606,000
Montana	272,174,000	228,416,000	319,089,000	308,582,000
Ohio	499,834,000	427,161,000	490,039,000	542,904,000
Indiana	401,017,000	360,613,000	422,963,000	556,418,000
Missouri	422,470,000	418,586,000	501,691,000	660,159,000
Oklahoma	168,806,000	143,869,000	164,663,000	225,730,000
Massachusetts	259,329,000	273,317,000	239,206,000	361,200,000
Vermont	235,983,000	239,254,000	284,815,000	351,571,000
Arizona	76,287,000	73,139,000	72,655,000	62,731,000
New Mexico	82,650,000	83,728,000	83,544,000	91,987,000
Maryland	174,320,000	144,078,000	154,554,000	267,939,000
Colorado	88,451,000	95,908,000	121,398,000	141,710,000
Connecticut	109,251,000	124,661,000	126,463,000	168,371,000
Illinois	122,528,000	96,651,000	113,506,000	170,181,000
New Jersey	34,810,000	28,639,000	36,542,000	61,620,000
South Dakota	20,986,000	13,046,000	16,340,000	31,057,000
Iowa	46,593,000	59,974,000	75,446,000	132,021,000
Wyoming	13,560,000	33,309,000	30,931,000	28,602,000
Rhode Island	14,421,000	9,016,000	14,392,000	25,489,000
Delaware	28,285,000	23,853,000	46,642,000	55,440,000
Utah	9,055,000	10,573,000	11,786,000	12,638,000
Kansas				
All other States	[3] 22,525,000	[3] 11,786,000	[3] 12,594,000	[3] 15,946,000

[1] Includes also exclusive lath and shingle mills reporting (1,500 estimated).
[2] Mills cutting less than 50,000 feet per year excluded.
[3] Includes Kansas, Nebraska, and Nevada.

TABLE 5.—*Total number of active sawmills reporting and quantity of lumber reported or computed, by States, 1899–1916*—Continued.

	1908 (31,231 mills).[1]	1907 (28,850 mills).[1]	1904 (18,277 mills).[2]	1899 (31,833 mills).
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
Total	33,224,369,000	40,256,154,000	34,135,139,000	35,084,166,000
Washington	2,915,928,000	3,777,606,000	2,485,628,000	1,429,032,000
Louisiana	2,722,421,000	2,972,119,000	2,459,327,000	1,115,366,000
Mississippi	1,861,016,000	2,094,485,000	1,727,391,000	1,206,265,000
Oregon	1,468,158,000	1,635,563,000	987,107,000	734,538,000
North Carolina	1,136,796,000	1,622,387,000	1,318,411,000	1,286,638,000
Texas	1,524,008,000	2,229,590,000	1,406,473,000	1,232,404,000
Arkansas	1,656,991,000	1,988,504,000	1,680,536,000	1,623,987,000
Alabama	1,152,079,000	1,224,967,000	1,243,988,000	1,101,386,000
Wisconsin	1,613,315,000	2,003,279,000	2,623,157,000	3,389,166,000
Florida	730,906,000	839,058,000	812,693,000	790,373,000
California	996,115,000	1,345,943,000	1,077,499,000	737,035,000
Virginia	1,198,725,000	1,412,477,000	949,797,000	959,119,000
Michigan	1,478,252,000	1,827,685,000	2,006,670,000	3,018,338,000
West Virginia	1,097,015,000	1,395,979,000	855,889,000	778,051,000
Minnesota	1,286,122,000	1,660,716,000	1,942,248,000	2,342,338,000
Georgia	904,668,000	853,697,000	1,135,910,000	1,311,917,000
Maine	929,350,000	1,103,808,000	863,860,000	784,647,000
South Carolina	560,888,000	649,058,000	609,769,000	466,429,000
Idaho	518,625,000	513,788,000	211,447,000	65,363,000
Pennsylvania	1,203,041,000	1,734,729,000	1,738,972,000	2,333,278,000
Tennessee	790,642,000	894,968,000	775,885,000	950,958,000
Kentucky	658,539,000	912,908,000	586,371,000	774,651,000
New York	781,391,000	848,894,000	581,976,000	878,448,000
New Hampshire	606,760,000	754,023,000	491,591,000	572,447,000
Montana	311,533,000	343,814,000	236,430,000	255,685,000
Ohio	459,259,000	529,087,000	420,905,000	990,497,000
Indiana	411,868,000	504,790,000	563,853,000	1,036,999,000
Missouri	458,938,000	548,774,000	553,940,000	723,754,000
Oklahoma	158,756,000	140,015,000	32,730,000	22,104,000
Massachusetts	384,526,000	364,231,000	262,467,000	344,190,000
Vermont	304,017,000	373,660,000	337,238,000	375,809,000
Arizona	43,287,000	72,134,000	55,601,000	36,182,000
New Mexico	79,439,000	113,204,000	81,113,000	30,880,000
Maryland	168,534,000	213,786,000	166,469,000	183,711,000
Colorado	117,036,000	134,239,000	141,914,000	133,746,000
Connecticut	137,855,000	140,011,000	69,376,000	108,093,000
Illinois	123,319,000	141,317,000	211,545,000	388,469,000
New Jersey	34,930,000	39,942,000	44,058,000	74,118,000
South Dakota	25,859,000	34,841,000	13,705,000	31,704,000
Iowa	97,242,000	144,271,000	281,521,000	352,411,000
Wyoming	18,822,000	17,479,000	7,990,000	16,963,000
Rhode Island	30,528,000	32,855,000	15,398,000	18,528,000
Delaware	41,184,000	50,892,000	30,416,000	35,955,000
Utah	15,059,000	14,690,000	12,630,000	17,548,000
Kansas	.....	.....	.....	.....
All other States	10,627,000	[3] 5,891,000	[4] 23,245,000	[4] 24,646,000

[1] Includes also exclusive lath and shingle mills reporting (1,500 estimated).
[2] Custom mills excluded.
[3] Includes Kansas and Nevada.
[4] Includes Alaska, Kansas, Nebraska, Nevada, and North Dakota in 1899.

TABLE 6.—*Quantity of each kind of lumber reported, 1899–1910, and computed total production in 1915 and 1916.*

Kind of wood.	1916	1915	1914	1913
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
Total	[1] 39,807,251,000	[1] 37,011,656,000	37,346,023,000	38,387,009,000
Yellow pine	15,055,000,000	14,700,000,000	14,472,804,000	14,839,363,000
Douglas fir	5,416,000,000	4,431,249,000	4,763,693,000	5,556,098,000
Oak	3,300,000,000	2,970,000,000	3,278,908,000	3,211,718,000
White pine	2,700,000,000	2,700,000,000	2,632,587,000	2,568,636,000
Hemlock	2,350,000,000	2,275,000,000	2,165,728,000	2,319,982,000
Western yellow pine	1,690,000,000	1,293,985,000	1,327,365,000	1,253,528,000
Spruce	1,250,000,000	1,400,000,000	1,245,614,000	1,046,815,000
Cypress	1,000,000,000	1,100,000,000	1,013,013,000	1,097,247,000
Maple	975,000,000	900,000,000	909,743,000	901,487,000
Gum, red and sap	800,000,000	655,000,000	675,380,000	772,514,000
Yellow poplar	560,000,000	464,000,000	519,221,000	620,176,000
Chestnut	535,000,000	490,000,000	540,591,000	595,802,000
Redwood	490,850,000	420,294,000	535,199,000	510,271,000
Larch	455,000,000	375,000,000	358,561,000	395,273,000
Birch	450,000,000	415,000,000	430,667,000	378,739,000
Cedar	410,000,000	420,000,000	499,903,000	358,444,000
Beech	360,000,000	360,000,000	376,464,000	365,501,000
Tupelo	275,000,000	170,000,000	124,480,000	120,420,000
Basswood	275,000,000	260,000,000	264,656,000	257,102,000
Elm	240,000,000	210,000,000	214,294,000	214,532,000
Ash	210,000,000	190,000,000	189,499,000	207,816,000
Cottonwood	200,000,000	180,000,000	195,198,000	208,938,000
White fir	190,000,000	125,048,000	112,627,000	88,109,000
Sugar pine	169,250,000	117,701,000	136,159,000	149,926,000
Hickory	125,000,000	100,000,000	116,113,000	162,980,000
Balsam fir	125,000,000	100,000,000	125,212,000	93,752,000
Walnut	90,000,000	90,000,000	25,573,000	40,565,000
Sycamore	40,000,000	25,000,000	22,773,000	30,891,000
Lodgepole pine	30,800,000	26,486,000	18,374,000	20,106,000
All other kinds	40,351,000	47,893,000	55,624,000	85,366,000

Kind of wood.	1912	1911	1910	1909
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
Total	39,158,414,000	37,003,207,000	40,018,282,000	44,509,761,000
Yellow pine	14,737,052,000	12,896,706,000	14,143,471,000	16,277,185,000
Douglas fir	5,175,123,000	5,054,243,000	5,203,644,000	4,856,378,000
Oak	3,318,952,000	3,098,444,000	3,522,098,000	4,414,457,000
White pine	3,138,227,000	3,230,584,000	3,352,183,000	3,900,034,000
Hemlock	2,426,554,000	2,555,308,000	2,856,129,000	3,051,399,000
Western yellow pine	1,219,444,000	1,330,700,000	1,562,106,000	1,499,985,000
Spruce	1,238,600,000	1,261,728,000	1,449,912,000	1,748,547,000
Cypress	997,227,000	981,527,000	935,659,000	955,635,000
Maple	1,020,864,000	951,667,000	1,806,637,000	1,106,604,000
Gum, red and sap	694,260,000	582,967,000	610,208,000	706,945,000
Yellow poplar	623,289,000	659,475,000	734,926,000	858,500,000
Chestnut	554,230,000	529,022,000	535,049,000	663,891,000
Redwood	496,796,000	489,768,000	543,493,000	521,630,000
Larch	407,064,000	368,216,000	382,514,000	421,214,000
Birch	388,272,000	432,571,000	420,769,000	452,370,000
Cedar	329,000,000	374,925,000	415,039,000	346,008,000
Beech	435,250,000	403,881,000	437,325,000	511,244,000
Tupelo	122,545,000	98,142,000	92,071,000	96,676,000
Basswood	296,717,000	304,621,000	344,704,000	399,151,000
Elm	262,141,000	236,108,000	265,107,000	347,456,000
Ash	234,548,000	214,398,000	246,035,000	291,209,000
Cottonwood	227,477,000	198,629,000	220,305,000	265,600,000
White fir	122,613,000	124,307,000	132,327,000	89,318,000
Sugar pine	132,416,000	117,987,000	103,165,000	97,191,000
Hickory	278,757,000	240,217,000	272,252,000	333,929,000
Balsam fir	84,261,000	83,375,000	74,580,000	108,702,000
Walnut	43,083,000	38,293,000	36,449,000	46,108,000
Sycamore	49,468,000	42,836,000	45,063,000	56,511,000
Lodgepole pine	22,039,000	33,014,000	26,634,000	23,733,000
All other kinds	82,145,000	69,548,000	68,428,000	62,151,000

[1] Computed total production by kinds of wood.

TABLE 6.—*Quantity of each kind of lumber reported, 1899–1916, and computed total production in 1915 and 1916*—Continued.

Kind of wood.	1908	1907	1904	1899
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
Total	33,224,369,000	40,256,154,000	134,135,139,000	135,084,166,000
Yellow pine	11,236,372,000	13,215,185,000	11,521,681,000	9,657,676,000
Douglas fir	3,675,111,000	4,748,872,000	2,928,409,000	1,736,507,000
Oak	2,771,511,000	3,718,760,000	2,902,855,000	4,438,027,000
White pine	3,311,921,000	4,192,708,000	5,332,701,000	7,732,391,000
Hemlock	2,530,843,000	3,375,016,000	3,268,787,000	3,420,673,000
Western yellow pine	1,275,550,000	1,527,195,000	1,290,626,000	945,432,000
Spruce	1,411,992,000	1,726,797,000	1,303,886,000	1,448,091,000
Cypress	743,297,000	757,639,000	749,592,000	495,836,000
Maple	874,983,000	939,073,000	587,558,000	633,466,000
Gum, red and sap	589,347,000	689,200,000	523,990,000	285,417,000
Yellow poplar	654,122,000	862,849,000	853,551,000	1,115,242,000
Chestnut	539,341,000	653,239,000	243,537,000	206,688,000
Redwood	464,802,000	569,450,000	519,267,000	360,167,000
Larch	382,466,000	324,509,000	31,784,000	50,619,000
Birch	386,367,000	387,614,000	224,009,000	132,601,000
Cedar	272,764,000	251,002,000	223,035,000	232,978,000
Beech	410,072,000	430,005,000	(2)	(2)
Tupelo	69,170,000	68,842,000	(2)	(2)
Basswood	319,505,000	381,088,000	228,041,000	308,069,000
Elm	273,845,000	260,579,000	258,330,000	456,731,000
Ash	225,367,000	252,040,000	169,178,000	269,120,000
Cottonwood	232,475,000	293,161,000	321,574,000	415,124,000
White fir	98,120,000	146,508,000	(2)	(2)
Sugar pine	99,809,000	115,005,000	(2)	53,558,000
Hickory	197,372,000	203,211,000	106,824,000	96,636,000
Balsam fir	69,056,000	53,339,000	(2)	(2)
Walnut	43,681,000	41,490,000	31,455,000	38,681,000
Sycamore	43,332,000	46,044,000	18,002,000	29,715,000
Lodgepole pine	(2)	(2)	(2)	(2)
All other kinds	47,873,000	27,734,000	496,461,000	514,721,000

[1] Includes lumber cut in Alaska. [2] Not separately reported.

LUMBER PRODUCTION BY KINDS OF WOOD.

Ready comparison of the cut of the different woods for 12 years, the same period for which the cut is given by States in the preceding table, is made possible in Table 6 (p. 12). The computation indicates an enlarged output each year, with but a few exceptions, for such species as southern yellow pine, Douglas fir, western yellow pine, cypress, maple, red and sap gum, birch, cedar, tupelo, sugar pine, and walnut. On the other hand, the cut has remained practically stationary or declined for such other woods as oak, white pine, hemlock, spruce, yellow poplar, chestnut, beech, basswood, elm, ash, cottonwood, and hickory. Natural laws of supply and demand have but partially governed the cut of different species, since exploitation of some woods has resulted in an increased demand and production, while other woods have suffered through heightened values due to diminished supply and the substitution of less costly species.

Figures 2 and 3 supplement Tables 5 and 6 by showing graphically the computed figures on 1916 lumber production by States and by species, respectively.

LUMBER PRODUCTION BY SPECIES.

The tabulations in the following pages give the cut by species, summarizing by States the number of mills reporting, the quantity of lumber reported cut, the average value per 1,000 feet f. o. b. mill,

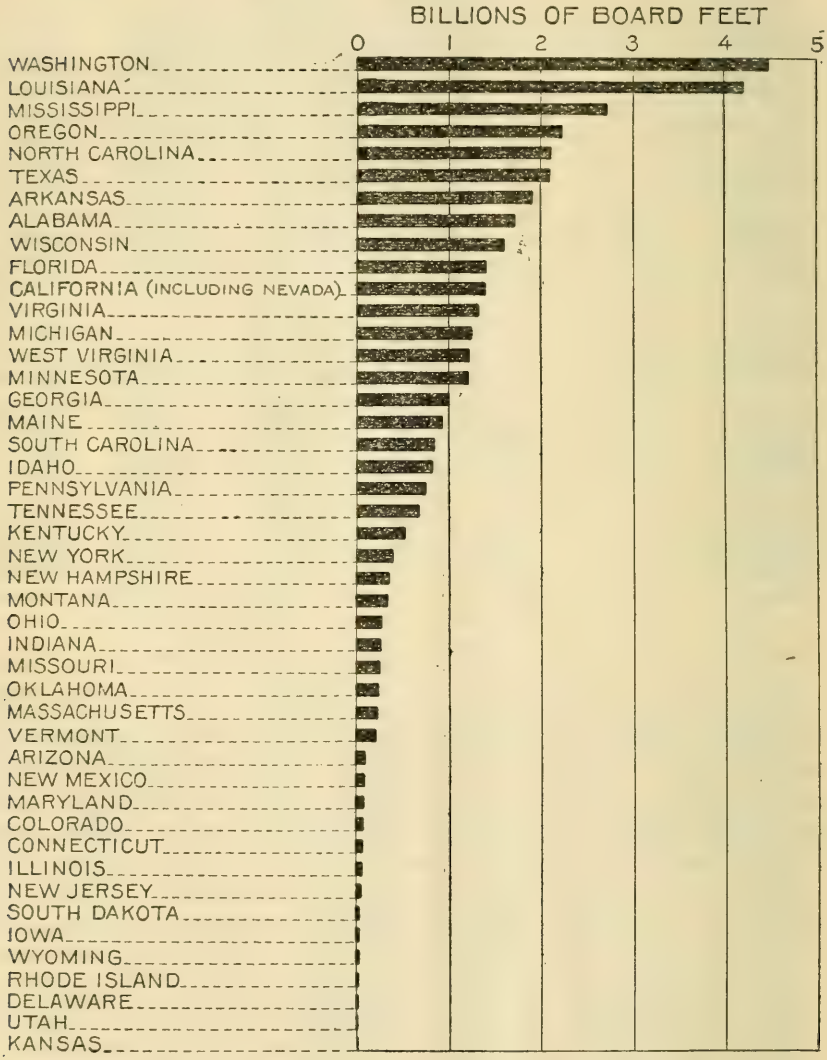

FIG. 2.—Computed total lumber production in 1916 by States.

and the computed total production. The computed figure for total production is given because it is not possible to obtain returns from every sawmill throughout the country through correspondence, particularly where the furnishing of data is purely voluntary. The need of accurate statistics is generally understood by lumbermen, so that

returns from the larger organizations are almost complete. In making the computations, careful consideration was given to all available data and the figures may be regarded as conservatively correct.

It is not practicable in this bulletin to distinguish the several species which go to make up a given kind of wood, such as yellow pine or oak, because no universal classification exists among the lumbermen. The result is that the several yellow pines are grouped in a single table and the oaks are treated in the same manner.

Not all of the mills which reported their production returned mill values of the lumber, but the figures given are those of more than one-half of the 17,269 mills that scheduled data on their output.

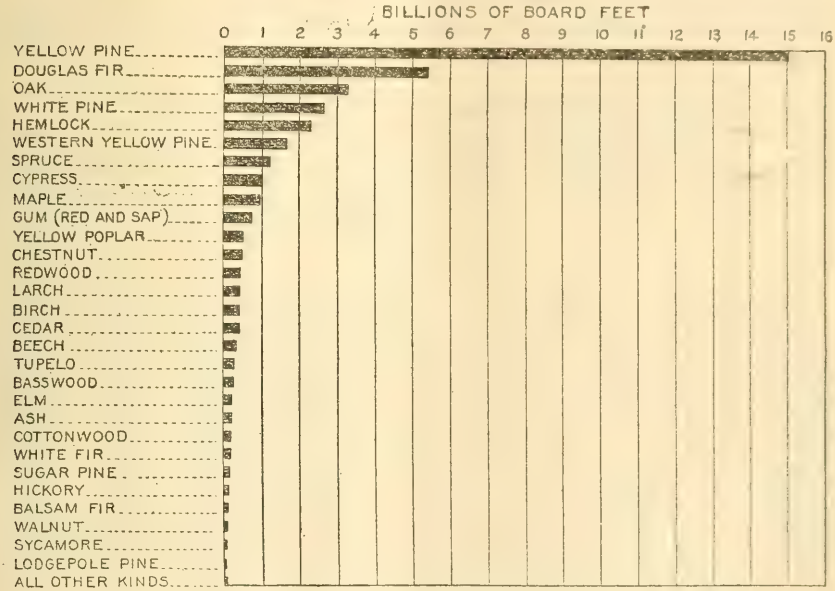

FIG. 3.—Computed total lumber production in 1916 by kinds of wood.

Variations in the prices shown are directly attributable to conditions affecting the mills located within the State, the principal factors being the quantity and quality of the timber cut, proximity to consuming markets, and character of the stock produced. Comparison and analysis of the prices returned on each schedule insured results of considerable accuracy.

YELLOW PINE.

Under the broad classification of yellow pine is included the various yellow pines grown in the eastern and southern sections of the United States. The three species contributing chiefly to the aggregate output are longleaf (*Pinus palustris*), loblolly (*Pinus tæda*), and shortleaf (*Pinus echinata*).

The reported production of yellow pine in 1916 was 13,411,411,000 feet, an increase of 1,234,076,000 feet, or approximately 10 per cent over 1915. Increased production is in evidence in all the States listed with the exception of Arkansas, Missouri, Tennessee, and Kentucky, where decreased output is recorded. The only change in the relative rank as producing States was in the displacement of Arkansas by Alabama in fifth position, due to a greater output in the latter State by approximately 157,000,000 feet without any material difference in production in Arkansas. Reports were received from 6,592 active mills in 1916 as contrasted with 6,006 in 1915.

The computed total production of yellow pine in the United States is nearly 2.5 per cent greater for 1916 than for the preceding year—15,055,000,000 feet as against 14,700,000,000 feet.

There was an advance in the average value from $12.41 per 1,000 feet in 1915 to $14.33 in 1916.

TABLE 7.—*Reported production of yellow pine lumber, 1916.*

(Computed total production in United States, 15,055,000,000 feet b. m.)

	Number of active mills reporting.	Quantity reported.	Percent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	6,592	13,411,411,000	100.0	$14.33
Louisiana	236	3,063,468,000	22.9	14.89
Mississippi	497	1,963,285,000	14.6	14.77
Texas	272	1,649,334,000	12.3	15.22
North Carolina	1,322	1,232,849,000	9.2	13.20
Alabama	693	1,180,318,000	8.8	13.06
Arkansas	410	1,075,973,000	8.0	15.26
Florida	214	976,516,000	7.3	13.85
South Carolina	437	643,586,000	4.8	13.67
Virginia	995	632,649,000	4.7	13.96
Georgia	699	621,419,000	4.6	12.96
Oklahoma	48	207,501,000	1.6	13.82
Tennessee	247	42,697,000	.3	13.11
Maryland	125	28,786,000	.2	13.73
Missouri	91	26,851,000	.2	13.21
Kentucky	101	12,633,000	.1	15.01
All other States (see summary, p. 38)	205	53,546,000	.4	.....

DOUGLAS FIR.

Douglas fir (*Pseudotsuga taxifolia*), which is the principal commercial species of the Western States and of which more exists in standing timber than any other one species, was produced to the extent of 5,413,431,000 feet, nearly one and one-quarter billion feet (31.33 per cent) more than in 1915. The quantity cut approaches the record of five and one-half billion feet made in 1913. A feature of the 1916 figures is the increase in Oregon over 1915 of more than 100 in the number of active mills and nearly 500,000,000 feet in the cut; the State's proportion of the total quantity cut grew from 27.2 per cent to 29 per cent.

Because of the better facilities for securing data on Douglas fir production, which insured reports from all but a few mills, the computed production figure is only slightly larger than the cut actually reported.

The average value for 1916 is $10.78 per 1,000 feet, an advance of but 19 cents from 1915. The increase in value did not keep pace with the greater output; nor does the sum mentioned approach the advance in the f. o. b. mill value of some competitive woods.

TABLE 8.—*Reported production of Douglas fir lumber, 1916.*

(Computed total production in United States, 5,416,000,000 feet b m.)

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	1,175	5,413,431,000	100.0	$10.78
Washington	349	3,546,532,000	65.5+	10.85
Oregon	430	1,572,469,000	29.0	10.28
California and Nevada	100	141,200,000	2.6	12.84
Idaho	140	80,632,000	1.5−	11.28
Montana	59	56,845,000	1.1	13.88
All other States (see summary, p. 38)	97	15,753,000	.3	.....

OAK.

Oak ranks third in importance in the production of this country's woods, and has a wide distribution. Commercially the oaks are classified as red and white, though there are more than 50 species in the United States. Statistically it is impracticable to do more than show the production of all the oaks together.

The cut of oak is declining, but some of the older producing regions continue to saw annually a surprisingly large quantity. The production figures for 1916 show 2,164,633,000 feet actually reported by 9,400 mills, as compared with 2,070,444,000 feet by 9,517 mills the preceding year. The per cent of increase is 4.5

The production rank of the several States shifted to a considerable extent between 1915 and the succeeding year. West Virginia and Arkansas remained in first and second places, respectively, in 1916; Kentucky succeeded Tennessee in third place; Mississippi moved up from tenth to sixth position, displacing Ohio, whose rank became ninth; and North Carolina took Pennsylvania's position in seventh place. The trend in oak production is further indicated by the increase in cut during 1916 in Virginia, North Carolina, Mississippi, Alabama, and Texas.

The computed cut for 1916 is placed at 3,300,000,000 feet.

There was a substantial increase in the average value, $1.33 per 1,000 feet—from $18.73 in 1915 to $20.06 in 1916.

TABLE 9.—*Reported production of oak lumber, 1916.*

[Computed total production in United States, 3,300,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	9,400	2,164,633,000	100.0	$20.06
West Virginia	459	298,189,000	13.8	20.96
Arkansas	441	246,264,000	11.4	18.75
Tennessee	729	225,645,000	10.4	21.06
Kentucky	563	212,768,000	9.8	21.21
Virginia	857	184,226,000	8.5	16.21
Mississippi	269	129,131,000	6.0	19.86
North Carolina	841	129,124,000	6 0	16 37
Pennsylvania	750	113,780,000	5.3	21.08
Ohio	513	102,405.000	4.7	26.00
Missouri	357	95,850,000	4.4	17.90
Indiana	431	83,674,000	3.9	29.71
Louisiana	90	71,968,000	3.3	18.79
Alabama	345	41,881,000	1.9	15.57
Texas	100	39,114,000	1.8	17.10
Georgia	229	24,006,000	1.1	17.91
New York	664	23,926,000	1.1	25.13
Illinois	109	20,972,000	1.0	19.91
All other States (see summary, p. 38)	1,653	121,710,000	5.6	.....

WHITE PINE.

White-pine data as given here include four species: The white pine (*Pinus strobus*) and Norway or red pine (*Pinus resinosa*) of the Lake States, New England, and Appalachian regions; western white pine (*Pinus monticola*) of the Inland Empire region; and jack pine (*Pinus divaricata*) of the Lake States. To some extent Norway and jack pine are mixed with the lower grades of white pine and sold as the latter, since these species are as well adapted as white pine for the purposes for which it is used.

White-pine production continues without any remarkable change, the reported cut of 2,330,831,000 feet in 1916 being an increase of 1.7 per cent over the 1915 figures of 2,291,480,000 feet. A reference to the tabulation reveals Minnesota's share of the country's reported cut to have been 41.5 per cent, which is an increase of 3.5 per cent over the previous year.

With the exception of the three leading producing States—Minnesota, Idaho, and Maine—and North Carolina, where the quantity cut was almost doubled, the production of the several States listed shows a decline from 1915, slight in nearly all instances, but none the less significant.

No change was made in the computed total production of white pine for 1915, since it is generally conceded that this wood has reached the maximum cut.

The number of mills reporting in 1916 was less by 137 out of a total of 3,212 than the year before.

The average f. o. b. mill value was $19.16 per 1,000 feet, an advance of $1.72 per 1,000 feet.

TABLE 10.—*Reported production of white-pine lumber, 1916.*

[Computed total production in United States, 2,700,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	3,212	2,330,831,000	100.0	$19.16
Minnesota	154	962,765,000	41.3	18.61
Idaho	36	304,055,000	13.0	19.34
Maine	476	272,035,000	11.7	19.00
Wisconsin	237	187,447,000	8.0	23.30
New Hampshire	272	184,728,000	7.8	17.72
Massachusetts	218	101,567,000	4.4	16.62
Washington	30	64,128,000	2.8	16.62
Michigan	155	64,040,000	2.7	23.17
New York	753	50,145,000	2.2	23.82
North Carolina	126	32,833,000	1.4+	15.54
Pennsylvania	322	31,732,000	1.4−	24.07
Vermont	100	13,924,000	.6	19.03
West Virginia	53	11,619,000	.5−	19.92
Montana	10	10,497,000	.5−	16.40
Connecticut	65	10,283,000	.4	19.64
All other States (see summary, p. 38)	207	29,033,000	1.2	.....

HEMLOCK.

Hemlock is cut in both the Eastern and Western States, the principal species being *Tsuga canadensis* and *Tsuga heterophylla* in the respective regions. The wide distribution of the species is indicated by the number of States listed in the tabulation.

TABLE 11.—*Reported production of hemlock lumber, 1916.*

[Computed total production in United States, 2,350,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	3,538	1,986,653,000	100.0	$15.35
Wisconsin	234	527,465,000	26.6	15.53
Michigan	229	324,720,000	16.3	15.40
Washington	80	267,313,000	13.5−	10.23
Pennsylvania	429	243,810,000	12.3	19.40
West Virginia	133	161,554,000	8.1	17.01
Maine	439	96,300,000	4.8	15.91
New York	1,007	79,880,000	4.0	19.18
Oregon	23	70,014,000	3.5+	10.04
New Hampshire	212	43,165,000	2.2	15.80
North Carolina	77	42,916,000	2.2	14.83
Virginia	73	35,952,000	1.8	14.84
Tennessee	42	25,977,000	1.3	13.32
Vermont	270	25,257,000	1.3−	16.87
Massachusetts	117	15,770,000	.8	17.48
Kentucky	58	15,649,000	.8	15.86
All other States (see summary, p. 38)	115	10,911,000	.5+	.....

A decrease of slightly less than 2 per cent in the cut was actually reported in comparison with the 1915 figures—1,986,653,000 feet in 1916 and 2,026,460,000 feet in 1915. Wisconsin produced more than one-fourth of the reported cut of all the States, the figures indicating an increase of 53,000,000 feet over 1915; Michigan's cut decreased 48,000,000 feet for the same period. Hemlock production for the

United States as a whole has been well sustained during the last seven years.

The computed cut was placed at 2,350,000,000 feet, an increase of 75,000,000 feet, or about 3 per cent.

While 3,538 mills reported their cut, this number is 201 less than for the previous report.

The average f. o. b. mill value advanced from $13.14 to $15.35, or $2.21, the largest increases being in the eastern product.

WESTERN YELLOW PINE.

Western yellow pine (*Pinus ponderosa*), which is cut in practically each one of the Western States, gained nearly 35 per cent in reported production in 1916 over the previous year, the figures being 1,684,987,000 feet and 1,252,244,000 feet, respectively. The noteworthy increase is largely accounted for by Oregon's cut being almost twice as great as in 1915. Oregon ranked third in the list of producing States in 1915 and cut approximately 15 per cent of the total quantity of western yellow pine reported for all States; in 1916 this State supplanted Idaho in second place in the list with 24 per cent of the total cut to its credit. With the exception of Colorado, the output in all of the other States was accelerated. The largely increased cut of western yellow pine places that wood in sixth place according to quantity produced for all species, displacing spruce in that position.

The computed total output of 1,690,000,000 feet for the country is an increase of 31 per cent over 1915.

The average value of the lumber f. o. b. mill for 1916 is $14.52; the year before it was $14.32.

TABLE 12.—*Reported production of western yellow pine lumber, 1916.*

[Computed total production in United States, 1,690,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	787	1,684,987,000	100.0	$14.52
California	133	494,973,000	29.4	15.40
Oregon	163	399,102,000	23.7	13.75
Idaho	118	240,160,000	14.2	14.47
Washington	119	188,215,000	11.2	12.94
Montana	65	138,206,000	8.2	14.76
Arizona	16	92,133,000	5.5	15.80
New Mexico	51	72,004,000	4.3	13.50
Colorado	52	27,848,000	1.6	13.96
South Dakota	25	25,466,000	1.5+	19.05
All other States (see summary, p. 38)	45	6,880,000	.4	.....

SPRUCE.

Red spruce (*Picea rubens*) and Sitka spruce (*Picea sitchensis*) form the bulk of the spruce production, the former being manufactured in the New England and Appalachian regions and the latter in Washington and Oregon.

The reported total cut of 1,129,750,000 feet is 5.4 per cent less than in 1915. This decreased output of lumber is in a measure accounted for by the quantity of spruce timber which was cut for pulpwood rather than for saw logs; New Hampshire's output was less by one-half and New York's less by one-quarter than the reported cut of 1915. The two States mentioned furnish much spruce to pulp mills.

The three leading States in the production of spruce—Maine, Washington, and West Virginia—enlarged their cut in 1916; but the increase in these three States was not enough to offset the decrease in the other States. A feature of the tabulation is the position of Oregon in fourth place in importance of production, the State having occupied seventh position in 1915. Oregon's greater cut, as well as that of Washington, is attributed to the heavier demand during the year for spruce airplane stock.

The computed total cut of spruce is given as 1,250,000,000 feet, which is a decrease of 10.7 from the year before.

The average f. o. b. mill value of $17.58 is higher by exactly $1 than the 1915 value.

TABLE 13.—*Reported production of spruce lumber, 1916.*

[Computed total production in United States, 1,250,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	1,477	1,129,750,000	100.0	$17.58
Maine	357	376,820,000	33.4	19.22
Washington	65	221,295,000	19.6	14.08
West Virginia	19	111,965,000	9.9	20.40
Oregon	23	96,245,000	8.5+	11.96
Vermont	264	66,812,000	5.9	18.96
New Hampshire	127	54,337,000	4.8	19.10
North Carolina	7	45,540,000	4.0	21.37
New York	223	41,551,000	3.7	21.25
Minnesota	72	25,357,000	2.2	17.25
Colorado	42	18,614,000	1.7	16.35
Massachusetts	38	14,638,000	1.3	19.41
California	2	13,871,000	1.2+	14.44
Idaho	22	13,537,000	1.2−	13.42
All other States (see summary, p. 38)	216	29,138,000	2.6	.....

CYPRESS.

Cypress (*Taxodium distichum*) production, as reported, reached a total of 945,330,000 feet, or 2 per cent more than the cut of the preceding year.

The output of the mills in Louisiana, North Carolina, and Mississippi was slightly less in 1916 than in 1915. Louisiana, while still the leading State of production, cut but 56 per cent instead of 61 per cent of the total reported cypress cut in all States. Cypress production has been maintained at about the same rate since 1909, the exploitation of timber in recent years in States hitherto little logged tending to make up for the smaller output in the older cypress log-

ging sections. The computed total cut of the country, however, is 1,000,000,000 feet, which is 9 per cent less than for 1915.

The average f. o. b. mill value advanced from $19.85 in 1915 to $20.85 per 1,000 feet in 1916.

TABLE 14.—*Reported production of cypress lumber, 1916.*

[Computed total production in United States, 1,000,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	726	945,350,000	100.0	$20.85—
Louisiana	97	527,425,000	55.8	21.45
Florida	42	188,799,000	20.0	22.24
Georgia	64	54,305,000	5.8	20.06
South Carolina	38	44,810,000	4.7	17.14
Arkansas	137	36,347,000	3.8	18.02
Missouri	50	25,555,000	2.7+	16.55
North Carolina	90	25,500,000	2.7—	15.65
Mississippi	74	17,417,000	1.8	22.18
All other States (see summary, p. 38)	134	25,172,000	2.7	.....

MAPLE.

Hard or sugar maple (*Acer saccharum*) and silver maple (*Acer saccharinum*) are the two species chiefly lumbered in the Northern States, and red maple (*Acer rubrum*) in the Southern States.

The quantity actually reported cut in 1916 was 809,341,000 feet, an increase of 4.9 per cent over the 1915 figures. The cut of maple has remained almost uniform during a period of 10 years. Michigan continues to put out more maple lumber than any other one of the States, the proportion being 45 per cent of the total for the country.

The computed total production was 975,000,000 feet; the previous year it was 900,000,000 feet.

There was an advance in the f. o. b. mill value during the year of $3.03 to an average of $18.24.

TABLE 15.—*Reported production of maple lumber, 1916.*

[Computed total production in United States, 975,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	4,131	809,341,000	100.0	$18.24
Michigan	271	365,456,000	45.2	18.90
Wisconsin	278	146,480,000	18.1	16.15
West Virginia	208	70,900,000	8.8	19.11
New York	846	50,551,000	6.2	19.90
Pennsylvania	453	43,422,000	5.4	17.44
Ohio	359	25,733,000	3.2	18.46
Indiana	321	19,730,000	2.4	22.31
Vermont	216	18,465,000	2.3	18.22
Virginia	85	10,090,000	1.2	16.91
All other States (see summary, p. 38)	1,094	58,514,000	7.2	.....

RED GUM.

Red gum (*Liquidambar styraciflua*), the sapwood of which is also commercially called "sap gum," was reported cut to the amount of 651,879,000 feet. The output was 36.3 per cent greater than that reported for 1915. The increase is partially accounted for by organized exploitation of uses for the wood.

Each one of the leading producing States, with the exception of Tennessee, Missouri, and South Carolina, measurably increased its cut, the output in Arkansas increasing 35.3 per cent, that in Mississippi 49.6 per cent, and that in Louisiana 92 per cent—a combined increase in cut of 145,000,000 feet.

The computed total production was 800,000,000 feet in 1916 and 655,000,000 feet in 1915.

Along with the enlarged cut of gum there was an advance in the average mill value from $12.54 per 1,000 feet in 1915 to $14.64 in 1916.

TABLE 16.—*Reported production of red gum lumber, 1916.*

[Computed total production in United States, 800,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	1,845	651,879,000	100.0	$14.64
Arkansas	245	207,148,000	31.8	14.14
Mississippi	174	164,949,000	25.3	16.19
Louisiana	77	75,926,000	11.6	14.01
Tennessee	186	23,917,000	3.7	16.27
North Carolina	141	23,647,000	3.6	15.13
Texas	49	23,592,000	3.6	14.75
Alabama	92	22,813,000	−3.5	12.08
Missouri	60	21,951,000	3.4	14.81
South Carolina	43	20,297,000	3.1	13.57
Virginia	111	16,008,000	−2.5	12.70
Georgia	43	12,306,000	1.9	14.80
All other States (see summary, p. 38)	624	39,325,000	6.0	.....

YELLOW POPLAR.

Yellow poplar (*Liriodendron tulipifera*) production statistics show a tendency since 1909 toward a restricted output. The cut actually reported in 1916, 394,854,000 feet, was 4.6 per cent greater than for the year previous.

Kentucky dropped in rank as a producing State from second to fourth place, Tennessee and Virginia moving up proportionately. Ohio, once a large source of poplar timber, occupies eighth place as against sixth place in 1915.

The computed cut of 560,000,000 feet was larger than that of 1915 (464,000,000 feet) and that of 1913, but below the reported cut for a series of years.

While practically all other woods show statistically an advance in average mill value for 1916, the poplar figures of $21.89 indicate a slight loss.

TABLE 17.—*Reported production of yellow poplar lumber, 1916.*

[Computed total production in United States, 560,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	2,906	394,854,000	100.0	$21.89
West Virginia	304	102,515,000	26.0	25.52
Tennessee	394	47,591,000	12.1	22.90
Virginia	365	47,022,000	11.9	20.50
Kentucky	337	40,544,000	10.3	22.13
North Carolina	284	37,272,000	9.4	17.54
Georgia	110	28,569,000	7.2	18.17
Alabama	164	27,265,000	6.9	15.55
Ohio	204	18,491,000	4.7	30.33
South Carolina	73	16,350,000	4.1	16.66
Mississippi	81	10,841,000	2.7	19.59
All other States (see summary, p. 38)	590	18,391,000	4.7	.....

CHESTNUT.

Chestnut (*Castanea dentata*) lumber production was partially influenced by the efforts to utilize the timber killed by the chestnut blight. The reported cut of 419,581,000 feet is but 5 per cent more than the quantity reported by the mills in 1915.

Massachusetts operators made the best showing, relatively, in increased output among the individual States. Connecticut and New York also increased their cut over the preceding year.

The computed total production of chestnut for 1916 was 535,000,000 feet.

The average mill value was $17.05; in 1915 it was $16.17.

TABLE 18.—*Reported production of chestnut lumber, 1916.*

[Computed total production in United States, 535,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	3,197	419,581,000	100.0	+$17.05
West Virginia	331	132,192,000	+31.5	17.39
Pennsylvania	633	51,146,000	12.2	17.45
North Carolina	236	46,497,000	11.1	17.41
Virginia	318	37,270,000	8.9	15.28
Connecticut	143	30,722,000	7.3	18.50
Tennessee	257	26,844,000	6.4	16.10
Massachusetts	129	23,135,000	+5.5	16.69
Kentucky	244	17,416,000	4.1	16.26
New York	438	15,540,000	3.7	17.68
Maryland	89	9,572,000	2.3	14.41
New Jersey	77	8,704,000	2.1	16.53
All other States (see summary, p. 38)	302	20,543,000	4.9	.....

REDWOOD.

Redwood (*Sequoia sempervirens*) and bigtree (*Sequoia washingtoniana*), which are without distinction marketed as redwood, are cut exclusively in California, though the range of the former extends into southwest Oregon.

The tabulation shows an increase of two mills in the number reporting and a total cut of 490,828,000 feet, or 17 per cent more than the quantity reported cut in 1915. The figure given is believed to include practically all redwood lumber manufactured.

The average mill value of $13.93 per 1,000 feet was an advance of 39 cents per 1,000 feet over the 1915 value.

TABLE 19.—*Reported production of redwood lumber, 1916.*

[Computed total production in United States, 490,850,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	34	490,828,000	100.0	$13.93
California	34	490,828,000	100.0	13.93

LARCH.

Western larch (*Larix occidentalis*) and tamarack (*Larix laricina*) are the two species of larch cut in the Western and Eastern States, respectively, the output reported in 1916 aggregating 376,731,000 feet. This is an increase of 8.1 per cent over the cut of 1915, and is in line with the annual production of the last 10 years.

Montana mills sawed nearly 50,000,000 feet more in 1916 than the year before, bringing up that State's proportion of the total output of the country from 33 to 43 per cent. The cut in both Minnesota and Oregon was less by nearly one-half than in 1915.

The average value f. o. b. mill for 1916 was $12.49, an advance of $1.71 over the value for the previous year.

TABLE 20.—*Reported production of larch lumber, 1916.*

[Computed total production in United States, 455,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	559	376,731,000	100.0	$12.49
Montana	33	163,829,000	43.4	12.87
Idaho	50	107,827,000	28.6	10.69
Wisconsin	138	32,607,000	8.7	15.81
Washington	46	30,534,000	8.1	9.78
Michigan	113	16,568,000	4.4	15.99
Minnesota	104	15,557,000	4.1	15.53
Oregon	13	8,478,000	2.3	12.00
All other States (see summary, p. 38)	62	1,331,000	.4	.....

BIRCH.

Yellow birch (*Betula lutea*) and sweet or cherry birch (*Betula lenta*) are the two species which constitute the bulk of the birch production of the country. The reported cut in 1916 reached a total of 365,943,000 feet, which exceeds the 1915 cut by 3 per cent.

Wisconsin, Michigan, Maine, and New York, the leading States in production, show an increased output. Wisconsin's proportion of the aggregate cut of the country advanced from 46 per cent to 49 per cent.

The computed total cut of 450,000,000 feet is in line with the production of the last three years, during which time much has been done to foster the demand for birch.

The average mill value reached $19.59 per 1,000 feet in 1916; in 1915 it was $16.52.

TABLE 21.—*Reported production of birch lumber, 1916.*

[Computed total production in United States, 450,000,000 feet b. m.]

	Number of active mills.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	1,849	365,943,000	100.0	$19.59
Wisconsin	245	179,549,000	49.1	19.51
Michigan	165	59,251,000	16.2	20.75
Maine	191	28,088,000	7.7	19.94
New York	183	23,192,000	6.3+	20.79
Vermont	218	22,980,000	6.3−	19.26
West Virginia	112	16,590,000	4.5+	20.40
New Hampshire	107	10,376,000	2.8	15.25
Minnesota	65	8,341,000	2.3	16.76
Pennsylvania	220	7,839,000	2.1	18.29
All other States (see summary, p. 38)	342	9,737,000	2.7	.....

CEDAR.

The term "cedar," as used in this bulletin, embraces several species which make up the bulk of the cut in the respective regions. Western red cedar (*Thuja plicata*) is the species cut in Washington, Oregon, and Idaho; Port Orford cedar (*Chamæcyparis lawsoniana*) in Oregon; northern white cedar, or arborvitæ (*Thuja occidentalis*) in the Lake States and Northeastern States; incense cedar (*Libocedrus decurrens*) in California; southern white cedar, which also is called "juniper," (*Chamæcyparis thyoides*) in Atlantic Coast States; and red cedar (*Juniperus virginiana* and *J. barbadensis*) in Tennessee, Florida, and Alabama.

In rather sharp contrast with the production of other woods, the cedar cut in 1916 of 322,003,000 feet is smaller than the reported cut for 1915. The decline indicated is 8.6 per cent and is directly traceable to the decrease in Washington of 46,000,000 feet in the output and 13 in the number of mills reporting. Washington cut 57 per cent of the total for the entire country in 1915 and but 48 per cent in 1916.

In 1915 Michigan and Wisconsin held seventh and eighth place, respectively, in rank among the producing States; but in 1916 these positions were taken by North Carolina and Tennessee.

The computed total cut for 1916 is given as 410,000,000 feet, which is 10,000,000 feet less than for the preceding year.

Consistent with the decreased cut was the depressed average mill value of $15.24 per 1,000 feet, a drop from $16.10 per 1,000 feet in 1915.

TABLE 22.—*Reported production of cedar lumber, 1916.*

[Computed total production in United States, 410,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	649	322,003,000	100.0	$15.24
Washington	89	155,532,000	48.3	13.46
Oregon	43	46,138,000	14.3	15.35
Idaho	9	35,981,000	11.2	10.32
Virginia	23	21,230,000	6.6	30.61
California	47	16,587,000	5.1	13.05
Maine	71	9,582,000	3.0	16.88
North Carolina	36	6,883,000	2.1+	18.48
Tennessee	82	6,675,000	2.1−	30.74
Michigan	31	6,369,000	2.0	14.04
Wisconsin	41	5,034,000	1.6	15.39
All other States (see summary, p. 38)	177	11,992,000	3.7	.....

BEECH.

Beech (*Fagus atropunicea*) is another one of the hardwoods in which annual statistics show a tapering off in production during the last 10 years. The cut in 1916 was 6.7 per cent less than that in 1915. The total reported output for 1916 was 283,363,000 feet.

The lessened output was apparent in nearly every one of the States listed in the accompanying table, with the exception of Michigan, which cut approximately 330,000 feet more than in 1915, and Indiana, which moved from sixth into third place in production rank.

The average mill value for 1916 was $16.20; in 1915 it was $14.01.

TABLE 23.—*Reported production of beech lumber, 1916.*

[Computed total production in United States, 300,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	3,162	283,363,000	100.0	$16.20
Michigan	194	66,316,000	23.4	16.50
Pennsylvania	444	38,712,000	13.7	16.75
Indiana	366	37,082,000	13.1	18.53
West Virginia	209	35,634,000	12.3	14.66
New York	552	30,350,000	10.7	17.13
Ohio	378	22,777,000	8.0	16.07
Kentucky	254	17,170,000	6.1	13.10
Vermont	165	9,345,000	3.3	15.88
Tennessee	170	7,411,000	2.6	13.78
New Hampshire	58	5,153,000	1.8	14.04
All other States (see summary, p. 38)	372	13,413,000	4.7	.....

TUPELO.

Tupelo statistics, as given in this bulletin, cover production of cotton gum (*Nyssa aquatica*), commercially called tupelo, and black gum, or pepperidge (*Nyssa sylvatica*). Prior to 1915 many of the mills reported their cut of black gum with red gum.

The reported cut of tupelo in 1916 of 214,239,000 feet is 40 per cent more than the quantity reported produced the year before; the increase is correlative with the increase of 36.3 per cent in red gum as previously noted.

A feature of the output for the year is the enlarged cut in Louisiana, which is 81 per cent in excess of the year before, and which advanced the State's production from 41 per cent to 53 per cent of the total for all States. Several other changes occurred in the relative rank of the larger producing States, Alabama assuming second from fourth place in 1915 and North Carolina dropping from second place into fourth.

The computed total production was 275,000,000 feet; it was 170,000,000 feet the preceding year.

The average mill value of $13 per 1,000 feet was an increase of 75 cents per 1,000 feet over the 1915 value.

TABLE 24.—*Reported production of tupelo lumber, 1916.*

[Computed total production in United States, 275,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	618	214,239,000	100.0	$13.00
Louisiana	50	113,115,000	52.8	13.56
Alabama	43	22,416,000	10.5	12.43
Virginia	31	21,235,000	9.9	12.41
North Carolina	38	8,338,000	3.9	10.70
Mississippi	43	8,216,000	3.8	12.67
South Carolina	17	7,363,000	3.4	13.46
Missouri	24	6,329,000	3.0	11.65
Tennessee	68	6,083,000	2.8	10.92
Arkansas	56	5,497,000	2.6	12.06
All other States (see summary, p. 38)	248	15,647,000	7.3	.....

BASSWOOD.

Basswood, sometimes called linden or linn (*Tilia americana*) is cut mostly in the Lake States, and white basswood (*Tilia heterophylla*) and other species in the Appalachian Mountain region.

The reported cut of 209,275,000 feet in 1916 is less than 1 per cent more than that scheduled for the previous year. The peak in basswood cut statistics was reached in 1909, and since that year the output has gradually diminished.

Wisconsin, Michigan, West Virginia, and New York remain the leading States in production, each having a reported cut of approximately the same quantity as in 1915.

An increase of $2.16 per 1,000 feet in average mill value, which reached $21.05, was recorded for 1916.

TABLE 25.—*Reported production of basswood lumber, 1916.*

[Computed total production in United States, 275,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	2,668	209,275,000	100.0	$21.05+
Wisconsin	269	72,618,000	34.7	21.15
Michigan	217	36,756,000	17.6	22.07
West Virginia	187	28,955,000	13.8	20.82
New York	708	14,630,000	7.0	22.98
Virginia	57	7,030,000	3.4	21.18
North Carolina	87	7,028,000	3.3	19.83
Minnesota	66	5,985,000	2.9	17.15
Vermont	163	5,868,000	2.8	19.27
Tennessee	59	5,107,000	2.4	19.76
Ohio	174	5,049,000	2.4	22.07
All other States (see summary, p. 38)	681	20,249,000	9.7	.....

ELM.

Elm is commercially classified as soft elm and rock elm. White or American elm (*Ulmus americana*) and slippery or red elm (*Ulmus pubescens*) are generally sold as soft elm. Cork elm (*Ulmus racemosa*) is the real rock elm and distinguished as such by the lumber trade.

The production reported in 1916 totaled 195,266,000 feet, which s an increase of 9.8 per cent over the preceding year's cut. Production for the last few years has remained almost stationary.

Wisconsin and Michigan enlarged their output slightly in 1916, and their combined cut amounted to nearly one-half of the production for the entire country.

The computed cut was 240,000,000 feet.

The average mill value was $19.46 per 1,000 feet.

TABLE 26.—*Reported production of elm lumber, 1916.*

[Computed total production in United States, 240,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	2,681	195,266,000	100.0	$19.46
Wisconsin	265	51,946,000	26.6	19.27
Michigan	226	42,479,000	21.8	22.15
Indiana	301	19,039,000	9.7	21.50
Arkansas	93	17,948,000	9.2	17.74
Ohio	278	10,681,000	5.5—	19.67
Missouri	121	9,836,000	5.0	15.92
New York	487	8,353,000	4.3	19.10
Tennessee	129	8,230,000	4.2	18.29
Mississippi	66	7,161,000	3.7	18.34
All other States (see summary, p. 38)	715	19,593,000	10.0	.....

ASH.

Ash production is largely of three species—white ash (*Fraxinus americana*), black ash (*Fraxinus nigra*), and green ash (*Fraxinus lanceolata*)—though trade customs characterize the species as white ash and brown ash, the latter being the black ash. The white ash is found largely in the central hardwood region, the New England States, and the Lake States. Black ash is cut in the Lake States. The Southern States provide the green ash.

The older settled States are being displaced as the principal sources of supply for ash, Arkansas and Louisiana now ranking first and second, respectively, with Ohio, Indiana, and Michigan taking lesser rank.

The reported cut in 1916 was 156,204,000 feet. This quantity is 2.3 per cent less than the 1915 reported cut.

The computed cut of 210,000,000 feet indicates but a small reduction from the output of the country during the last five years.

The average mill value of ash in 1916 was $23.85.

TABLE 27.—*Reported production of ash lumber, 1916.*

[Computed total production in United States, 210,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	3,493	156,204,000	100.0	$23.85–
Arkansas	107	23,117,000	14.8	22.43
Louisiana	57	16,175,000	10.4	23.50
Wisconsin	210	13,621,000	8.7	21.46
Tennessee	180	12,020,000	7.7	25.90
Mississippi	86	8,524,000	5.5–	24.97
Indiana	237	8,190,000	5.2	31.07
West Virginia	128	7,710,000	4.9	25.57
Ohio	292	7,476,000	4.8	31.12
New York	647	7,359,000	4.7+	25.10
Michigan	180	7,273,000	4.7–	22.53
All other States (see summary, p. 38)	1,369	44,739,000	28.6	.....

COTTONWOOD.

Cottonwood, produced largely in the lower Mississippi Valley States, is of several related species. The greater portion of the cut is the common cottonwood (*Populus deltoides*).

Of the reported cut of 134,980,000 feet in 1916 nearly two-thirds was sawed by mills in Mississippi, Arkansas, and Louisiana. Statistics show the output of cottonwood has dwindled during the last 10 years. Between 1915 and 1916 the decrease was 2.4 per cent.

The average mill value of $17.42 is but a few cents higher than the value established for the year previous.

TABLE 28.—*Reported production of cottonwood lumber, 1916.*

[Computed total production in United States, 200,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	928	134,980,000	100.0	$17.42
Mississippi	42	35,398,000	26.2	19.65
Arkansas	49	27,524,000	20.4	16.87
Louisiana	33	18,405,000	13.6	18.79
Minnesota	74	11,863,000	8.8	13.29
Missouri	54	5,331,000	4.0	20.11
Alabama	24	4,095,000	3.0	15.28
Tennessee	28	3,699,000	2.8	18.74
Michigan	37	2,834,000	2.1	13.82
Iowa	42	2,566,000	1.9	20.37
All other States (see summary, p. 38)	537	23,265,000	17.2	.....

WHITE FIR.

White fir (*Abies concolor*) statistics as given in this bulletin include several other species which are marketed as white fir, including grand fir (*Abies grandis*), silver fir (*Abies amabilis*), noble fir, sometimes erroneously called larch, red fir (*Abies magnifica*), and alpine fir (*Abies lasiocarpa*).

The somewhat remarkable increase of 56 per cent occurred in the 1916 over the 1915 reported production, the figures being 189,699,000 feet and 121,653,000 feet, respectively. The greater output was general, since the California and Nevada cut as well as that of Oregon was one-third larger. Idaho's cut increased by nearly one-half, while Washington's output was almost three times as much as that reported in 1915. The explanation of the bigger cut is in the fact that with the general increase in lumber prices, white fir sold at a price above the cost of production. Higher values resulted in white fir being logged with other species instead of being left in the woods.

The average mill value of $12.25 is next to the lowest value scheduled for any species.

TABLE 29.—*Reported production of white fir lumber, 1916.*

[Computed total production in United States, 190,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	231	189,699,000	100.0	$12.25+
California and Nevada	64	85,918,000	45.3	13.06
Idaho	45	60,344,000	31.8	12.14
Oregon	47	20,451,000	10.8	10.10
Washington	34	18,042,000	9.5	10.75
Montana	5	3,408,000	1.8	13.77
All other States (see summary, p. 38)	36	1,536,000	.8	.....

SUGAR PINE.

Sugar pine (*Pinus lambertiana*) production in 1916 was the largest for any one year for which data are recorded. It totaled 169,247,000 feet, an increase in itself of 47 per cent over the quantity reported cut in 1915. The figures are those for 65 mills, in comparison with 42 mills which reported in 1915. To the larger number of operations may be attributed the greater proportion of the much swelled output, though apparently the mills found it expedient to enlarge their cut.

The average mill value of $16.77 per 1,000 feet is slightly under the 1915 value.

TABLE 30.—*Reported production of sugar pine lumber, 1916.*

[Computed total production in United States, 169,250,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	65	169,247,000	100.0	$16.77
California	54	165,461,000	97.8	16.87
Oregon	11	3,786,000	2.2	12.53

HICKORY.

Hickory lumber production in 1915 showed little change from that reported for the two years preceding. The 1916 reported cut of 93,454,000 feet is 8.6 per cent in excess of the cut of the year before. Five species are cut in the main—shagbark (*Hicoria ovata*), shellbark (*Hicoria laciniosa*), pignut (*Hicoria glabra*), bitternut (*Hicoria minima*), and mockernut (*Hicoria alba*). The quantity of hickory cut into lumber or plank has substantially decreased in the last few years, since the principal consumers want the material cut into dimension stock; it is also generally realized that the supply of hickory timber is diminishing.

The average value of hickory as reported by the mills was $23.84 per 1,000 feet; in 1915 it was $23.35.

TABLE 31.—*Reported production of hickory lumber, 1916.*

[Computed total production in United States, 125,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	2,500	93,454,000	100.0	$23.84
Arkansas	135	13,311,000	14.2	25.39
Tennessee	217	12,013,000	12.9	25.08
West Virginia	209	9,909,000	10.6	20.41
Kentucky	179	9,788,000	10.5−	20.03
Indiana	276	7,639,000	8.2	23.84
Mississippi	68	6,700,000	7.2	29.01
Ohio	322	6,575,000	7.0	26.43
Louisiana	31	4,370,000	4.7	20.96
Missouri	93	4,063,000	4.3	29.11
Pennsylvania	228	3,310,000	3.5+	21.30
All other States (see summary, p. 38)	742	15,776,000	16.9	.....

BALSAM FIR.

The production of balsam fir (*Abies balsamea*), also known simply as balsam, was increased 36 per cent in 1916 in comparison with the reported cut for the year before. The total cut reported was 97,165,000 feet.

The computed cut of 125,000,000 feet marks an almost unbroken advance in the production of this species, which was regarded as of little worth when other woods were more abundant.

The average mill value of $16.49 per 1,000 feet is an increase of $2.70 over the year previous.

TABLE 32.—*Reported production of balsam fir lumber, 1916.*

[Computed total production in United States, 125,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	578	97,165,000	100.0	$16.49
Maine	241	53,781,000	55.4	17.05
Minnesota	70	16,320,000	16.7	14.19
Michigan	47	10,373,000	10.7	16.60
Vermont	103	8,042,000	8.3	17.49
New Hampshire	32	4,854,000	5.0	16.73
Wisconsin	40	1,726,000	1.8	16.37
Massachusetts	8	1,293,000	1.3	14.50
All other States (see summary, p. 38)	37	776,000	.8	.....

WALNUT.

Walnut (*Juglans nigra*) production was stimulated in 1916 nearly as much as it was the year before to meet the continued exceptionally heavy demand for gunstock material, but the cut reported fell short by 6 per cent of the 1915 figures. The reported output was 61,167,000 feet and the computed cut 90,000,000 feet. With the exception of Kentucky and Iowa, the States listed in the tabulation reported a decreased cut in comparison with the output of the year before, which would confirm the belief generally shared by lumbermen that heavy inroads have been made upon the available supply of the common black walnut.

TABLE 33.—*Reported production of walnut lumber, 1916.*

[Computed total production in United States, 90,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	1,204	61,167,000	100.0	$42.38
Missouri	73	12,140,000	19.8	46.33
Indiana	203	10,691,000	17.4	43.95
Tennessee	144	8,658,000	14.2	36.87
Kentucky	153	8,138,000	13.3	37.13
Iowa	32	6,497,000	10.6	57.26
Ohio	160	6,026,000	9.9	40.63
Illinois	20	3,169,000	5.2	44.46
West Virginia	96	2,253,000	3.7	34.68
Virginia	54	1,334,000	2.2	23.66
All other States (see summary, p. 38)	269	2,261,000	3.7	.....

The average mill value dropped from $48.47 per 1,000 feet in 1915 to $42.38 in 1916.

SYCAMORE.

Sycamore (*Platanus occidentalis*) is produced chiefly in the Mississippi Valley region. In 1916 the total cut was 28,035,000 feet, an increase of 4.2 per cent over 1915. The computed production is given as 40,000,000 feet, since much is sawed by the very small mills and finds utilization on the farms.

The average mill value was $14.65 per 1,000 feet; in 1915 it was $13.86.

TABLE 34.—*Reported production of sycamore lumber, 1916.*

[Computed total production in United States, 40,000,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	931	28,035,000	100.0	$14.65
Arkansas	55	7,231,000	25.8	12.73
Indiana	204	3,958,000	14.15	18.15
Tennessee	74	3,680,000	13.2	12.51
West Virginia	32	2,360,000	8.4	17.15
Kentucky	107	1,933,000	6.9	14.48
Ohio	111	1,827,000	6.5	18.53
Missouri	95	1,789,000	6.4	14.10
Illinois	48	1,297,000	4.6	14.22
All other States (see summary, p. 38)	205	3,960,000	14.1	.....

LODGEPOLE PINE.

Lodgepole pine (*Pinus contorta*) is one of the woods for which additional use is being found each year and the production of which shows an annual increase. Even a greater quantity is cut into mine props, ties, poles, and other rough products than is manufactured into lumber. The reported cut increased 24.5 per cent in 1916 over 1915, reaching a total of 28,226,000 feet.

The average mill value advanced from $13.57 per 1,000 feet in 1915 to $15.13 in 1916.

TABLE 35.—*Reported production of lodgepole pine lumber, 1916.*

[Computed total production in United States, 30,800,000 feet b. m.]

	Number of active mills reporting.	Quantity reported.	Per cent.	Average value per M feet, f. o. b. mill.
		Feet b. m.		
United States	102	28,226,000	100.0	$15.13
Colorado	18	14,466,000	51.2	15.06
Wyoming	28	9,114,000	32.3	15.05
Idaho	25	2,097,000	7.4	16.13
Montana	17	1,631,000	5.8	14.07
Utah	14	918,000	3.3	16.77

MINOR SPECIES.

The production figures of a number of woods, both native and foreign, which are not of sufficient importance to tabulate and discuss separately, are given in Table 36. The foreign woods, such as mahogany, Spanish cedar, and Japanese oak, reach the United States largely in the form of round or squared logs. Not infrequently, some of the native species listed are mixed with and sold by sawmill operators as more commonly recognized woods, though several of the minor species have special uses, for which a ready demand exists.

TABLE 36.—*Minor species, 1916.*

[Computed total production in United States, 40,351,000 feet b. m.]

Kind of wood.	Quantity reported.	Average value per M feet, f. o. b. mill.	States reporting.
	Feet b. m.		
Total	32,879,000	$57.29	
Mahogany	13,244,000	107.47	La., Cal.
Cherry	7,872,000	28.34	W. Va., Pa., N. Y., N. C., Tenn., Mich., Ind., Ohio, Va., Mass., Ky., Wis., Conn., N. H.
Buckeye	3,161,000	15.44	W. Va., Tenn., N. C., Va., Ky., Ala., Ohio.
Cucumber	1,900,000	21.08	W. Va., Pa., N. Y., Ohio.
Willow	1,610,000	13.76	La., Miss., Pa., N. Y., Ky., Ark., Tenn.
Magnolia	1,359,000	14.41	Tex., La., Miss., Ala., Ga., S. C.
Locust	712,000	19.29	Pa., Ark., W. Va., N. C., Ill., La., Va., Ind., N. Y., Ky.
Japanese oak	553,000	62.00	Cal.
Eucalyptus	500,000	30.00	Cal.
Butternut	495,000	20.62	W. Va., N. Y., Ind., Mass., Wis., N. C., Ohio, Vt., Va., Iowa, Pa., Tenn., Mich.
Hackberry	421,000	15.30	Ark., La., Mo., Ind., Ohio, Ala., Tenn., Ga., Ill.
Laurel	300,000	40.00	Cal.
Pecan	140,000	14.96	Ark., La.
Persimmon	123,000	20.66	Miss., S. C., Ga., Ill., Ark.
Alder	119,000	12.55	Wash., Oreg., Cal.
Myrtle	81,000	[1]12.00	Oreg.
Red bay	81,000	12.09	Ga.
Japanese birch	69,000	[1] 50.00	Cal.
Boxelder	64,000	[1] 12.00	N. C., Ill.
Holly	35,000	19.34	Ala., La., Tenn.
Jenisero	18,000	80.00	Cal.
Sassafras	13,000	21.46	Tenn., S. C.
Hornbeam	6,000	25.00	N. H.
Mulberry	3,000	23.33	Ga.

[1] Arbitrary value assigned.

LATH.

Lath production in 1916 increased 15 per cent over that of 1915, 1,770 mills reporting a cut of 3,163,029,000 pieces. The enlarged output may be ascribed mainly to the 22 per cent increase in the value of building operations of the country in 1916 over the year before, which indicates a larger consumption of building materials, and to the higher cost of substitutes for lath, which led to a return to the more commonly used product of the sawmill. There was substantial enlargement of lath production in Maine, Michigan, Wisconsin, Oregon, and Idaho. The production in detail is given in Table 37.

The making of lath as a by-product of the larger operation is indicative of the closer utilization of timber.

TABLE 37.—*Reported production of lath, 1916, 1915, and 1912.*

	Number of active mills reporting.			Quantity reported (feet b. m.).		
	1916	1915	1912	1916	1915	1912
United States	1,770	1,689	2,586	3,163,029,000	2,745,134,000	2,719,163,000
Maine	139	122	172	396,935,000	172,346,000	210,023,000
Louisiana	69	66	65	354,551,000	418,554,000	330,474,000
Michigan	80	74	135	335,846,000	124,543,000	173,415,000
Minnesota	53	54	74	267,788,000	230,686,000	269,095,000
Washington	64	71	69	264,690,000	389,995,000	336,538,000
Wisconsin	121	116	192	218,598,000	179,193,000	257,657,000
Mississippi	30	29	22	162,689,000	123,011,000	81,315,000
Oregon	46	28	32	142,352,000	95,801,000	131,734,000
Idaho	24	29	20	117,365,000	85,672,000	50,895,000
West Virginia	80	70	121	96,665,000	82,561,000	159,119,000
North Carolina	111	106	116	86,551,000	96,474,000	94,086,000
Florida	28	23	26	85,187,000	89,860,000	51,078,000
Arkansas	30	48	43	78,157,000	97,185,000	90,216,000
All other States (see summary p. 38)	895	853	1,499	555,655,000	559,253,000	483,518,000

SHINGLES.

Table 38 shows the production of shingles, by States, in 1916, and for comparative purposes the quantity reported in 1915 and 1912. Shingle output statistics were not secured for either 1913 or 1914. The production of 9,477,077,000 shingles in 1916, while 12 per cent more than the output of the year before, is considerably below the production of 1912 and the immediately preceding years, in which the cut exceeded 12,000,000,000 annually. The number of active mills given in the tabulation as reporting—1,939—probably does not include all the plants making shingles, since many shingle mills are small and impermanent in character. Only a systematic county canvass in each State could secure an approximately correct enumeration. However, Washington produced 71 per cent of the total cut reported in 1916; and this and other important producing States in the West were covered intensively by the district offices of the Forest Service, so the production figures are believed to approach closely the actual output.

TABLE 38.—*Reported production of shingles, 1916, 1915, and 1912.*

	Number of active mills reporting.			Quantity reported (feet b. m.)		
	1916	1915	1912	1916	1915	1912
United States	1,932	1,648	3,615	9,477,077,000	8,459,378,000	12,037,685,000
Washington	238	239	387	6,739,388,000	6,313,335,000	7,996,251,000
Oregon	50	48	66	471,672,000	336,652,000	271,205,000
Louisiana	53	45	51	404,263,000	385,610,000	718,026,000
California	52	25	61	346,622,000	200,755,000	471,592,000
Maine	200	187	277	221,059,000	268,004,000	393,772,000
Michigan	69	63	159	201,171,000	250,640,000	459,359,000
Alabama	113	82	184	183,662,000	67,629,000	126,205,000
Wisconsin	73	77	159	175,455,000	122,882,000	267,945,000
Florida	51	31	76	131,795,000	116,054,000	309,081,000
Georgia	148	111	240	131,763,000	69,308,000	216,688,000
North Carolina	135	125	303	123,959,000	74,773,000	196,943,000
Idaho	9	11	8	79,960,000	49,512,000	37,641,000
Arkansas	42	31	78	45,411,000	20,501,000	114,458,000
Virginia	61	50	240	43,387,000	49,758,000	27,752,000
All other States (see summary, page 38)	638	523	1,326	175,440,000	133,965,000	430,767,000

LUMBER VALUES.

The compilation of average lumber values by species emphasizes a number of differences, such as might be expected to exist, between large and small mills, efficient and inefficient equipment and management, good and poor timber, proximity to and distance from important markets, and other factors which go to make up the individual operation. Not all of the mills which reported their cut for 1916 included average prices, but approximately 50 per cent of the reporting operators provided information used as the basis for Table 39. Mills operating under every condition in every section of each State contributed the figures from which the average for each species was determined, so that the figures can not be literally applied to the value of the product of a particular mill.

It is worthy of note that the average value of all species for 1916 is $15.32 per 1,000 feet, whereas it was $14.04 in 1915. Each one of the softwoods listed, with the exception of cedar and sugar pine, shows an increase in value over that of the year before, with which the 1916 figure is directly comparable. The same generally higher range of values applies to the hardwoods, among which the recessions are also limited to two—yellow poplar and walnut. While certain variations may appear to the lumberman as contrary to the figures of any one operation in which he may be interested, the values given are unquestionably typical.

TABLE 39.—*Average value of lumber per thousand feet, b. m., by kinds of wood, for specified years, 1899 to 1916.*

Kind of wood.	1916	1915	1912[1]	1911	1910	1909	1907	1904	1899
All kinds	$15.32	$14.04	$15.35	$15.05	$15.30	$15.38	$16.56	$12.76	$11.13
Softwoods:									
Yellow pine	14.33	12.41	14.36	13.87	13.29	12.69	14.02	9.96	8.46
Douglas fir	10.78	10.59	11.58	11.05	13.09	12.44	14.12	9.51	8.67
White pine	19.16	17.44	19.13	18.54	18.93	18.16	19.41	14.93	12.69
Hemlock	15.35	13.14	13.68	13.59	13.85	13.95	15.53	11.91	9.98
Spruce	17.58	16.58	17.02	16.14	16.62	16.91	17.26	14.03	11.27
Western yellow pine	14.52	14.32	13.62	13.62	14.26	15.39	15.67	11.30	9.70
Cypress	20.85	19.85	20.09	20.54	20.51	20.46	22.12	17.50	13.32
Redwood	13.93	13.54	14.13	13.99	15.52	14.80	17.70	12.83	10.12
Cedar	15.24	16.10	[2] 14.45	13.86	15.53	19.95	19.14	14.35	10.91
Larch (tamarack)	12.49	10.78	[3] 11.96	11.87	12.33	12.68	13.99	11.39	8.73
White fir	12.25	10.94	9.86	10.64	11.52	13.10	15.45	(4)	(4)
Sugar pine	16.77	17.40	(4)	17.52	18.68	18.14	19.84	(4)	12.30
Balsam fir	16.49	13.79	(4)	13.42	14.48	13.99	16.16	(4)	(4)
Lodgepole pine	15.13	13.57	(4)	12.41	14.88	16.25	(4)	(4)	(4)
Hardwoods:									
Oak	20.06	18.73	19.63	19.14	18.76	20.50	21.23	17.51	13.78
Maple	18.24	15.21	15.56	15.49	16.16	15.77	16.84	14.94	11.83
Red gum	14.64	12.54	12.60	12.11	12.26	13.20	14.10	10.87	9.63
Chestnut	17.05	16.17	16.62	16.63	16.23	16.12	17.04	13.78	13.37
Yellow poplar	21.89	22.45	24.06	25.46	24.71	25.39	24.91	18.99	14.03
Birch	19.59	16.52	17.43	16.61	17.37	16.95	17.37	15.44	12.50
Beech	16.20	14.01	13.51	14.09	14.34	13.25	14.30	(4)	(4)
Basswood	21.05	18.89	19.26	19.20	20.94	19.50	20.03	16.86	12.84
Elm	19.46	16.98	16.87	17.13	18.67	17.52	18.45	14.45	11.4
Ash	23.85	22.15	20.27	21.21	22.47	24.44	25.01	18.77	15.84
Cottonwood	17.42	17.36	[5] 20.44	18.12	17.78	18.05	18.42	14.92	10.37
Tupelo	13.00	12.25	13.61	12.46	12.14	11.87	14.48	(4)	(4)
Hickory	23.84	23.35	23.29	22.47	26.55	30.80	29.50	23.94	18.78
Walnut	42.38	48.47	(4)	31.70	34.91	42.79	43.31	45.64	36.49
Sycamore	14.65	13.86	(4)	13.16	14.10	14.77	14.58	(4)	11.04

[1] 1912 values based on limited number of reports.
[2] Western red cedar only.
[3] Western larch only.
[4] Data not obtained.
[5] Southern cottonwood only.

DETAILED SUMMARY.

In Table 40 is summarized the data presented in the individual species tables, showing, by States, the number of active sawmills reporting and their cut of each wood, and in addition the production of lath and shingles.

TABLE 40.—*Active sawmills (cutting 50,000 feet and over) reporting, and reported production of each kind of lumber and lath and shingles, by States, 1916.*

	Number of active mills reporting.	Aggregate.	Total.	Softwoods.	
				Yellow pine.	Douglas fir.
		Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
United States	17,269	34,791,385,000	28,576,292,000	13,411,411,000	5,413,431,000
Alabama	744	1,310,653,000	1,185,323,000	1,180,318,000	.....
Arizona	17	92,872,000	92,872,000	.....	634,000
Arkansas	706	1,668,493,000	1,112,440,000	1,075,973,000	.....
California and Nevada	182	1,413,541,000	1,411,989,000	.....	141,200,000
Colorado	96	67,368,000	67,221,000	.....	5,596,000
Connecticut	145	60,163,000	13,995,000	545,000	.....
Delaware	34	9,356,000	7,163,000	7,065,000	.....
Florida	225	1,179,717,000	1,165,518,000	976,516,000	.....
Georgia	710	753,930,000	677,724,000	621,419,000	.....
Idaho	190	846,107,000	844,660,000	.....	80,632,000
Illinois	114	43,731,000	2,036,000	150,000	.....
Indiana	471	209,354,000	108,000	52,000	.....
Iowa	61	18,027,000	55,000	50,000	.....
Kansas	5	534,000	.....	.....	.....
Kentucky	597	374,074,000	35,900,000	12,633,000	.....
Louisiana	329	3,910,866,000	3,590,893,000	3,063,468,000	.....
Maine	606	866,749,000	817,590,000	8,251,000	.....
Maryland	213	68,988,000	31,663,000	28,786,000	.....
Massachusetts	260	176,268,000	138,864,000	5,202,000	.....
Michigan	341	1,019,183,000	430,304,000	.....	.....
Minnesota	211	1,063,046,000	1,025,525,000	.....	.....
Mississippi	627	2,353,891,000	1,980,702,000	1,963,285,000	.....
Missouri	389	219,244,000	52,706,000	26,851,000	.....
Montana	103	383,884,000	383,818,000	.....	55,845,000
New Hampshire	305	336,064,000	297,078,000	9,659,000	.....
New Jersey	109	30,925,000	10,618,000	8,650,000	.....
New Mexico	55	80,406,000	80,406,000	.....	7,382,000
New York	1,260	349,908,000	172,932,000	.....	.....
North Carolina	1,532	1,657,032,000	1,386,521,000	1,232,849,000	.....
Ohio	546	219,042,000	1,210,000	135,000	.....
Oklahoma	91	232,198,000	208,252,000	207,501,000	.....
Oregon	525	2,221,854,000	2,216,769,000	.....	1,572,469,000
Pennsylvania	934	565,895,000	287,677,000	11,642,000	.....
Rhode Island	19	17,827,000	8,512,000	.....	.....
South Carolina	443	746,301,000	688,517,000	643,586,000	.....
South Dakota	27	26,450,000	25,466,000	.....	.....
Tennessee	768	488,242,000	88,572,000	42,697,000	.....
Texas	301	1,723,826,000	1,651,232,000	1,649,334,000	.....
Utah	76	9,383,000	9,007,000	.....	957,000
Vermont	335	180,234,000	114,738,000	40,000	.....
Virginia	1,210	1,036,209,000	704,429,000	632,649,000	.....
Washington	444	4,492,997,000	4,491,591,000	.....	3,546,532,000
West Virginia	475	1,009,156,000	287,247,000	2,105,000	.....
Wisconsin	386	1,240,778,000	759,753,000	.....	.....
Wyoming	52	16,619,000	16,606,000	.....	1,184,000

TABLE 40.—*Active sawmills (cutting 50,000 feet and over) reporting, and reported production of each kind of lumber and lath and shingles, by States, 1916*—Continued.

	Softwoods—Continued.					
	White pine.	Hemlock.	Western yellow pine.	Spruce.	Cypress.	Redwood.
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
United States	2,330,831,000	1,986,653,000	1,684,987,000	1,129,750,000	945,330,000	490,828,000
Alabama	.....	25,000	.....	.....	4,562,000	.....
Arizona	.....	.....	92,133,000	80,000	.....	.....
Arkansas	.....	.....	.....	.....	36,347,000	.....
California and Nevada	.....	3,151,000	494,973,000	13,871,000	.....	490,828,000
Colorado	.....	60,000	27,848,000	18,614,000	.....	.....
Connecticut	10,283,000	3,039,000	.....	10,000	.....	.....
Delaware	.....	.....	.....	.....	65,000	.....
Florida	.....	.....	.....	.....	188,799,000	.....
Georgia	1,450,000	540,000	.....	.....	54,305,000	.....
Idaho	304,055,000	27,000	240,160,000	13,537,000	.....	.....
Illinois	.....	.....	.....	.....	1,886,000	.....
Indiana	6,000	.....	.....	.....	.....	.....
Iowa	5,000	.....	.....	.....	.....	.....
Kansas	.....	.....	.....	.....	.....	.....
Kentucky	6,363,000	15,649,000	.....	15,000	286,000	.....
Louisiana	.....	.....	.....	.....	527,425,000	.....
Maine	272,035,000	96,300,000	.....	376,820,000	.....	.....
Maryland	1,861,000	820,000	.....	.....	163,000	.....
Massachusetts	101,567,000	15,770,000	.....	14,638,000	.....	.....
Michigan	64,040,000	324,720,000	.....	8,234,000	.....	.....
Minnesota	962,765,000	2,125,000	.....	25,357,000	.....	.....
Mississippi	.....	.....	.....	.....	17,417,000	.....
Missouri	.....	.....	.....	.....	25,555,000	.....
Montana	10,497,000	.....	138,206,000	6,790,000	.....	.....
New Hampshire	184,728,000	43,165,000	.....	54,337,000	.....	.....
New Jersey	.....	27,000	.....	.....	12,000	.....
New Mexico	.....	.....	72,004,000	1,020,000	.....	.....
New York	50,145,000	79,880,000	.....	41,551,000	.....	.....
North Carolina	32,833,000	42,916,000	.....	45,540,000	25,500,000	.....
Ohio	502,000	552,000	.....	.....	.....	.....
Oklahoma	.....	.....	.....	.....	750,000	.....
Oregon	86,000	70,014,000	399,102,000	96,245,000	.....	.....
Pennsylvania	31,732,000	243,810,000	.....	457,000	.....	.....
Rhode Island	7,965,000	545,000	.....	.....	.....	.....
South Carolina	.....	.....	.....	.....	44,810,000	.....
South Dakota	.....	.....	25,466,000	.....	.....	.....
Tennessee	6,966,000	25,977,000	.....	11,000	6,133,000	.....
Texas	.....	.....	.....	.....	1,852,000	.....
Utah	.....	.....	4,164,000	2,554,000	.....	.....
Vermont	13,924,000	25,257,000	.....	66,842,000	.....	.....
Virginia	3,514,000	35,952,000	.....	1,596,000	9,463,000	.....
Washington	64,128,000	267,313,000	188,215,000	221,295,000	.....	.....
West Virginia	11,619,000	161,554,000	.....	111,965,000	.....	.....
Wisconsin	187,447,000	527,465,000	.....	5,474,000	.....	.....
Wyoming	315,000	.....	2,716,000	2,897,000	.....	.....

TABLE 40.—*Active sawmills (cutting 50,000 feet and over) reporting, and reported production of each kind of lumber and lath and shingles, by States, 1916*—Continued.

	Softwoods—Continued.					
	Cedar.	Larch.	White fir.	Sugar pine.	Balsam fir.	Lodgepole pine.
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
United States	322,003,000	376,731,000	189,699,000	169,247,000	97,165,000	28,226,000
Alabama	418,000					
Arizona			25,000			
Arkansas	120,000					
California and Nevada	16,587,000		85,918,000	165,461,000		
Colorado			637,000			14,466,000
Connecticut	118,000					
Delaware	33,000					
Florida	203,000					
Georgia	10,000					
Idaho	35,981,000	107,827,000	60,344,000			2,097,000
Illinois						
Indiana	49,000	1,000				
Iowa						
Kansas						
Kentucky	954,000					
Louisiana						
Maine	9,582,000	821,000			53,781,000	
Maryland	33,000					
Massachusetts	290,000	104,000			1,293,000	
Michigan	6,369,000	16,568,000			10,373,000	
Minnesota	3,401,000	15,557,000			16,320,000	
Mississippi						
Missouri	300,000					
Montana	2,612,000	163,829,000	3,408,000			1,631,000
New Hampshire	300,000	35,000			4,854,000	
New Jersey	1,929,000					
New Mexico						
New York	463,000	172,000			721,000	
North Carolina	6,883,000					
Ohio	20,000	1,000				
Oklahoma	1,000					
Oregon	46,138,000	8,478,000	20,451,000	3,786,000		
Pennsylvania	3,000	33,000				
Rhode Island	2,000					
South Carolina	121,000					
South Dakota						
Tennessee	6,675,000	83,000			30,000	
Texas	46,000					
Utah			504,000			918,000
Vermont	552,000	81,000			8,042,000	
Virginia	21,230,000				25,000	
Washington	155,532,000	30,534,000	18,042,000			
West Virginia	4,000					
Wisconsin	5,034,000	32,607,000			1,726,000	
Wyoming	10,000		370,000			9,114,000

TABLE 40.—*Active sawmills (cutting 50,000 feet and over) reporting and reported production of each kind of lumber and lath and shingles, by States, 1916*—Continued.

	Hardwoods.					
	Total.	Oak.	Maple.	Yellow poplar.	Red gum.	Chestnut.
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
United States	6,215,093,000	2,164,633,000	809,341,000	394,854,000	651,879,000	419,581,000
Alabama	125,330,000	41,881,000	287,000	27,265,000	22,813,000	218,000
Arizona	.....	.....	.....	.....	.....	.....
Arkansas	556,053,000	246,264,000	6,092,000	784,000	207,148,000	.....
California and Nevada	1,552,000	30,000	35,000	.....	.....	.....
Colorado	147,000	.....	.....	.....	.....	.....
Connecticut	46,168,000	11,097,000	846,000	617,000	.....	30,722,000
Delaware	2,193,000	1,268,000	12,000	101,000	495,000	83,000
Florida	14,199,000	895,000	1,000	804,000	7,070,000	.....
Georgia	76,206,000	24,006,000	401,000	28,569,000	12,306,000	1,455,000
Idaho	1,447,000	.....	.....	.....	.....	.....
Illinois	41,695,000	20,972,000	1,322,000	542,000	3,539,000	1,000
Indiana	209,246,000	83,674,000	19,730,000	6,690,000	4,014,000	395,000
Iowa	17,972,000	3,702,000	789,000	.....	.....	.....
Kansas	534,000	241,000	3,000	.....	.....	.....
Kentucky	338,174,000	212,768,000	6,192,000	40,544,000	9,851,000	17,416,000
Louisiana	319,973,000	71,968,000	19,000	511,000	75,926,000	.....
Maine	49,159,000	6,666,000	6,094,000	.....	.....	540,000
Maryland	37,325,000	16,860,000	3,548,000	1,060,000	2,399,000	9,572,000
Massachusetts	37,404,000	6,692,000	1,949,000	152,000	.....	23,135,000
Michigan	588,879,000	7,320,000	365,456,000	304,000	.....	85,000
Minnesota	37,521,000	6,392,000	216,000	.....	.....	.....
Mississippi	373,189,000	129,131,000	931,000	10,841,000	164,949,000	.....
Missouri	166,538,000	95,850,000	6,352,000	254,000	21,951,000	.....
Montana	66,000	.....	.....	.....	.....	.....
New Hampshire	38,986,000	10,818,000	6,057,000	63,000	.....	4,392,000
New Jersey	20,307,000	9,273,000	434,000	225,000	417,000	8,704,000
New Mexico	.....	.....	.....	.....	.....	.....
New York	176,976,000	23,926,000	50,551,000	26,000	32,000	15,540,000
North Carolina	270,511,000	129,124,000	6,564,000	37,272,000	23,647,000	46,497,000
Ohio	217,832,000	102,405,000	25,733,000	18,494,000	2,017,000	6,663,000
Oklahoma	23,946,000	14,226,000	52,000	.....	5,710,000	.....
Oregon	5,085,000	417,000	1,862,000	.....	.....	.....
Pennsylvania	278,218,000	113,780,000	43,422,000	6,193,000	868,000	51,146,000
Rhode Island	9,315,000	2,445,000	125,000	65,000	.....	6,460,000
South Carolina	57,784,000	7,664,000	1,627,000	16,350,000	20,297,000	.....
South Dakota	984,000	2,000	.....	.....	.....	.....
Tennessee	399,670,000	225,645,000	6,451,000	47,591,000	23,917,000	26,844,000
Texas	72,594,000	39,114,000	38,000	.....	23,592,000	.....
Utah	286,000	.....	.....	.....	.....	.....
Vermont	65,496,000	2,842,000	18,465,000	.....	.....	251,000
Virginia	331,780,000	184,226,000	10,090,000	47,022,000	16,008,000	37,270,000
Washington	1,406,000	82,000	215,000	.....	.....	.....
West Virginia	721,909,000	298,189,000	70,900,000	102,515,000	2,913,000	132,192,000
Wisconsin	481,025,000	12,768,000	146,480,000	.....	.....	.....
Wyoming	13,000	10,000	.....	.....	.....	.....

TABLE 40.—*Active sawmills (cutting 50,000 feet and over) reporting, and reported production of each kind of lumber and lath and shingles, by States, 1916*—Continued.

	Hardwoods—Continued.						
	Beech.	Birch.	Basswood.	Cottonwood.	Elm.	Ash.	Hickory.
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*
United States	283,363,000	365,943,000	209,275,000	134,980,000	195,266,000	156,204,000	93,454,000
Alabama	1,133,000	8,000	183,000	4,095,000	505,000	2,268,000	2,021,000
Arizona	.....	.....	.....	.....	.....	.....	.....
Arkansas	45,000	1,000	383,000	27,524,000	17,948,000	23,117,000	3,311,000
California and Nevada	.....	.....	.....	27,000	.....	.....	.....
Colorado	.....	.....	.....	147,000	.....	.....	.....
Connecticut	343,000	595,000	136,000	100,000	104,000	746,000	825,000
Delaware	.....	200,000	.....	.....	.....	.....	14,000
Florida	11,000	2,000	.....	1,586,000	11,000	1,765,000	917,000
Georgia	246,000	74,000	285,000	1,077,000	344,000	4,315,000	712,000
Idaho	.....	.....	.....	1,447,000	.....	.....	.....
Illinois	589,000	35,000	106,000	976,000	2,118,000	1,684,000	1,058,000
Indiana	37,082,000	223,000	4,828,000	1,315,000	19,039,000	8,190,000	7,639,000
Iowa	5,000	147,000	1,393,000	2,566,000	2,256,000	267,000	241,000
Kansas	.....	.....	15,000	120,000	73,000	5,000	35,000
Kentucky	17,170,000	498,000	4,833,000	675,000	1,186,000	3,860,000	9,788,000
Louisiana	485,000	.....	33,000	18,405,000	3,516,000	16,175,000	4,370,000
Maine	2,837,000	28,088,000	1,517,000	1,204,000	357,000	1,853,000	.....
Maryland	399,000	497,000	896,000	42,000	79,000	389,000	956,000
Massachusetts	1,346,000	2,498,000	316,000	180,000	58,000	822,000	109,000
Michigan	66,316,000	59,251,000	36,756,000	2,834,000	42,479,000	7,273,000	380,000
Minnesota	11,000	8,341,000	5,985,000	11,863,000	3,329,000	1,375,000	1,000
Mississippi	134,000	.....	50,000	35,398,000	7,161,000	8,524,000	6,700,000
Missouri	33,000	91,000	246,000	5,331,000	9,836,000	2,223,000	4,063,000
Montana	.....	.....	.....	66,000	.....	.....	.....
New Hampshire	5,153,000	10,376,000	730,000	284,000	77,000	1,021,000	6,000
New Jersey	99,000	38,000	14,000	52,000	280,000	208,000	455,000
New Mexico	.....	.....	.....	.....	.....	.....	.....
New York	30,350,000	23,192,000	14,630,000	1,193,000	8,353,000	7,359,000	923,000
North Carolina	1,280,000	2,416,000	7,028,000	519,000	220,000	3,270,000	2,447,000
Ohio	22,777,000	570,000	5,049,000	764,000	10,681,000	7,476,000	6,575,000
Oklahoma	.....	.....	30,000	2,006,000	438,000	576,000	253,000
Oregon	.....	.....	.....	1,215,000	.....	1,496,000	.....
Pennsylvania	38,712,000	7,839,000	4,194,000	328,000	1,261,000	4,064,000	3,310,000
Rhode Island	50,000	70,000	.....	.....	.....	50,000	30,000
South Carolina	.....	.....	.....	199,000	478,000	3,350,000	110,000
South Dakota	.....	.....	.....	982,000	.....	.....	.....
Tennessee	7,411,000	1,189,000	5,107,000	3,699,000	8,230,000	12,020,000	12,013,000
Texas	77,000	3,000	61,000	996,000	721,000	4,950,000	2,063,000
Utah	.....	.....	.....	286,000	.....	.....	.....
Vermont	9,345,000	22,980,000	5,868,000	1,386,000	966,000	3,312,000	10,000
Virginia	2,591,000	582,000	7,030,000	374,000	76,000	790,000	2,144,000
Washington	.....	.....	.....	929,000	.....	80,000	.....
West Virginia	35,634,000	16,590,000	28,955,000	618,000	1,130,000	7,710,000	9,909,000
Wisconsin	1,699,000	179,549,000	72,618,000	2,169,000	51,946,000	13,621,000	66,000
Wyoming	.....	.....	.....	3,000	.....	.....	.....

TABLE 40.—*Active sawmills (cutting 50,000 feet and over) reporting, and reported production of each kind of lumber and lath and shingles, by States, 1916*—Continued.

	Hardwoods—Continued.				Lath.		Shingles.	
	Tupelo.	Walnut.	Sycamore.	Minor species.	Number of active mills reporting.	Quantity.	Number of active mills reporting.	Quantity.
	Feet b. m.	*Feet b. m.*	*Feet b. m.*	*Feet b. m.*		*Feet b. m.*		*Feet b. m.*
United States	214,239,000	61,167,000	28,035,000	32,879,000	1,770	3,163,029,000	1,932	9,477,077,000
Alabama	22,416,000	51,000	90,000	96,000	39	64,922,000	113	183,662,000
Arizona					6	24,918,000		
Arkansas	5,497,000	205,000	7,231,000	503,000	30	78,157,000	42	45,411,000
California and Nevada				1,460,000	19	30,713,000	52	348,622,000
Colorado					5	5,954,000	3	172,000
Connecticut	9,000	19,000	5,000	4,000	5	12,805,000	5	202,000
Delaware	20,000				1	30,000	3	89,000
Florida	1,137,000				28	85,187,000	51	131,795,000
Georgia	1,850,000	100,000	355,000	111,000	46	49,316,000	148	131,763,000
Idaho					24	117,365,000	9	79,960,000
Illinois	4,272,000	3,169,000	1,297,000	15,000	4	1,045,000		
Indiana	1,470,000	10,691,000	3,958,000	308,000	15	825,000	4	162,000
Iowa		6,497,000	91,000	8,000	1	500,000		
Kansas		27,000	15,000					
Kentucky	3,175,000	8,138,000	1,933,000	147,000	32	9,340,000	20	4,672,000
Louisiana	113,115,000	1,000	374,000	15,075,000	69	354,551,000	53	404,263,000
Maine		3,000			139	396,935,000	200	221,039,000
Maryland	144,000	101,000	383,000		25	5,774,000	19	1,601,000
Massachusetts		69,000		78,000	17	2,036,000	18	865,000
Michigan		175,000	135,000	115,000	80	335,846,000	69	201,171,000
Minnesota		8,000			53	267,788,000	12	6,577,000
Mississippi	8,216,000	64,000	499,000	591,000	30	162,689,000	29	25,196,000
Missouri	6,329,000	12,140,000	1,789,000	50,000	8	1,332,000	7	998,000
Montana					12	25,522,000	3	16,266,000
New Hampshire		2,000		7,000	19	18,398,000	37	3,543,000
New Jersey	64,000	40,000	4,000		32	5,808,000	32	17,876,000
New Mexico					5	10,851,000	1	320,000
New York	20,000	34,000	77,000	770,000	121	12,829,000	111	9,577,000
North Carolina	8,338,000	567,000	413,000	909,000	111	86,551,000	135	123,959,000
Ohio	647,000	6,026,000	1,827,000	128,000	39	6,976,000	2	125,000
Oklahoma		189,000	466,000		3	19,711,000	4	220,000
Oregon				95,000	46	142,352,000	50	471,762,000
Pennsylvania	581,000	423,000	212,000	1,885,000	187	63,016,000	105	8,652,000
Rhode Island		20,000					1	125,000
South Carolina	7,363,000	19,000	282,000	45,000	41	44,967,000	48	24,382,000
South Dakota					7	7,055,000	5	334,000
Tennessee	6,083,000	8,658,000	3,680,000	1,132,000	48	13,795,000	54	9,176,000
Texas	316,000	39,000	33,000	591,000	20	42,686,000	42	32,749,000
Utah					13	979,000	3	392,000
Vermont		60,000		11,000	25	9,990,000	52	7,993,000
Virginia	21,235,000	1,334,000	526,000	482,000	94	63,263,000	61	43,387,000
Washington				100,000	64	264,690,000	238	6,739,388,000
West Virginia	1,942,000	2,253,000	2,360,000	8,099,000	80	96,665,000	13	2,800,000
Wisconsin		45,000		64,000	121	218,598,000	73	175,455,000
Wyoming					6	289,000	5	376,000

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 674

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. PROFESSIONAL PAPER May 15, 1918

HEMORRHAGIC SEPTICEMIA.

By Henry J. Washburn,
Senior Pathologist, Pathological Division.

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CHARACTERISTICS.

Hemorrhagic septicemia is an infectious disease, attended with a very high mortality, which attacks various species of animals, especially cattle, sheep, and swine. Young animals are more susceptible to the disease than older ones, and those that are thin and poorly nourished are most liable to be affected.

The disease is a septicemia, or poisoning of the blood, wherefore it often runs a short course and the affected animal quickly dies. In suddenness of attack and high mortality at the beginning of an outbreak there is great resemblance to anthrax.

In hogs the disease is known as swine plague. The acute form is usually fatal to hogs within a few hours from the appearance of the first symptoms. In chronic cases the affected hogs gradually become weaker and thinner and may linger for several weeks.

Fowl cholera represents the avian form of hemorrhagic septicemia, and its attacks sometimes cause great losses. Pigeons and geese are susceptible to hemorrhagic septicemia and the introduction of the infection into flocks of birds of those kinds may lead to numerous fatalities.

The disease usually results in death so quickly at the beginning of an outbreak that no forms of treatment have time to become effective. The apparently healthy animals should be separated from the diseased and placed in clean, uninfected quarters, where they should be

given the best of feed and water. Bacterins, which may be purchased from the various manufacturers of biological products or from their agents throughout the country, have proved to be effective in many instances in checking the spread of an outbreak and in protecting the unaffected portion of the herd or flock.

HISTORY.

The disease occurred many years ago in this country in the form of swine plague. In 1885, through bacteriological studies that were carried on in the Bureau of Animal Industry, the *Bacillus bipolaris suisepticus* was identified as the cause of swine plague in the United States, and at the same time the disease was identified as the "Schweineseuche" of German writers.

Hemorrhagic septicemia appeared among cattle in Kimble County, Tex., in 1896. It was noted that many deer in Kimble County were affected at the same time, and the fatalities were very numerous. Those that were carefully examined showed typical lesions of hemorrhagic septicemia similar to those found in the affected cattle. It was not determined whether the deer or the cattle were the first to contract the disease.

In 1898 cattle owners in Tennessee lost many of their young animals from hemorrhagic septicemia. In this instance the infection appeared to be spread over a considerable area, and the disease seemed inclined to assume an unusually chronic character.

Several outbreaks occurred among cattle in Minnesota in 1900. The cases were carefully studied by Brimhall and Wilson, and the cultural characteristics of the microorganism that was isolated from the affected cattle were definitely established.

A year or two later some young cattle were affected while on a hilly pasture in central Virginia, where they had been feeding about one week when the disease appeared. Removing all the drove to a lowland pasture stopped the losses promptly. It was reported by the owner that it was necessary to abandon the mountain lot as a cattle pasture, as the disease recurred each spring if cattle were allowed to run over the infected areas.

During the month of December, 1911, the Department of Agriculture was notified by the Department of the Interior that a fatal disease had appeared among the buffaloes in the Yellowstone National Park, young animals being most susceptible. In all, 22 buffaloes died between December 3 and December 15. Examination of specimens of affected organs at the Washington laboratory of the bureau revealed an infection with the specific microorganism of hemorrhagic septicemia, and pure cultures of those bacilli were obtained. In order to prevent a recurrence of the infection in the

spring the entire herd of buffaloes was vaccinated with material prepared from the pure cultures obtained in Washington. Two vaccines of different strengths were prepared. The vaccine for the first inoculation was prepared by growing the organism 5 days at 42.5° C. (108° F.), while the second was cultivated at the same temperature for only 2 days.

This experiment was probably the first instance in which autogenic vaccines were used in the United States for the prevention of hemorrhagic septicemia, and its success was so marked that similar steps were taken afterwards to check outbreaks among cattle, sheep, and goats, so that at the present time bacterins for the inoculation of infected herds and flocks are prepared by several firms which manufacture biological products and may be purchased in all parts of the country.

Anthrax appeared in several counties in Texas in 1913, and during the investigation of the outbreak two cases of hemorrhagic septicemia were discovered, one in a horse and the other in a sheep. The organisms recovered were identical with the bacilli, which recently have been recovered from outbreaks of hemorrhagic septicemia in cattle and goats.

During the fall and winter of 1915–16 many cases were reported to the Bureau of Animal Industry in which young stock cattle that had been purchased in carload lots at some of the large stockyards had developed hemorrhagic septicemia within a few days after their arrival. At the same time two flocks of sheep and one of goats were found to be affected with the disease. Cultures of either the hemorrhagic septicemia group of organisms or cultures closely related to the colon or paratyphoid B group were recovered from these cases.

CAUSE OF THE DISEASE.

The organism of hemorrhagic septicemia, the *Bacillus bipolaris septicus*, belongs to the group in which the bacilli of chicken cholera, swine plague, and rabbit septicemia are to be found. This group is known also by the name Pasteurella. The individual organism is an ovoid, nonmotile, polar-staining bacterium with rounded ends, 1/38000 of an inch wide by 1/20000 of an inch long, sometimes seen in pairs or chains, but usually appearing singly. It stains readily with the stains usually used in bacteriological work, and in many cases shows deep staining at each end, while the middle of the bacillus shows but little coloring. It forms no gas and quickly destroys itself while growing on solid culture media by the development of acids.

The organism may be cultivated readily in bouillon and on agar and gelatin. The reaction of the medium should be slightly alkalin or neutral. It does not liquefy gelatin, coagulate milk, or produce indol.

The bipolar staining property of the organism may be demonstrated readily in preparations made from the tissues or body fluids (kidneys, blood, etc.), cultures of the organism usually giving less pronounced results in this respect.

Attempts have been made during an outbreak of hemorrhagic septicemia among cattle to transfer the disease from affected to healthy animals by means of rubbing saliva from diseased cattle into the mouths of healthy susceptible animals, and by injecting serum from the blood of a diseased yearling beneath the skin of susceptible young cattle, but without success. Many attempts to infect hogs by natural means from diseased cattle also have failed. In one instance, however, a colt that fed from the rack with a number of diseased sheep contracted the disease and died.

The spread of the disease seems to depend nearly as much upon the condition and susceptibility of the animal as upon the contagious nature of the disease, as thin, poorly nourished young stock most frequently become infected and die of septicemia.

In a number of outbreaks of a disease resembling hemorrhagic septicemia in all its manifestations and anatomical changes an organism which differs in cultural characteristics from the true *B. bipolaris septicus* has been recovered. This organism proves to be virulent for experimental animals (rabbits and guinea pigs), producing in them changes suggestive of hemorrhagic septicemia. In preparations from affected tissue or body fluids the organism stains bipolar, and usually occurs singly or occasionally in pairs. It differs from the true *B. bipolaris septicus* in that it appears slightly larger, possesses a sluggish motility, and produces gas in sugar media. In its cultural characteristics it corresponds in most instances to bacteria of the colon group, although some of the characteristics possessed by the paratyphoid B group have been noted.

Bipolar ovoid bacilli which closely resemble the organism of hemorrhagic septicemia are widely distributed in nature. They have been found in the soil, upon various plants, in stagnant water, and upon the moist nasal membranes of normal calves and hogs. In several instances these harmless organisms have been so increased in virulence by passing through animals that they finally proved to be fatal when injected into pigs, and in those instances the tissue changes, which were found at the autopsy of the pig, were similar to those found in swine that had died from swine plague.

It is thought by some writers that after the organisms have become virulent enough to cause an outbreak among animals, they will later, after that infection has been overcome, return to their previous harmless stage. The increased virulence which is made evident by an attack of several animals of a single species appears to be effective only in animals of that particular species, and the disease does not

spread to individuals of other species. For example, hogs and sheep that are pastured with a drove of cattle in which several deaths occur from hemorrhagic septicemia usually remain unaffected, although on another farm the sheep or the hogs alone may contract the disease and all the cattle escape. If any exceptions to this rule occur they are extremely rare.

SYMPTOMS.

In cattle the disease develops very rapidly, running a course of from 1 to 8 days. There is usually a steady elevation of body temperature until from 104° to 107° F. (40° to 41.67° C.) is reached. The animal refuses its feed. Swelling may appear beneath the skin of the head, throat, or dewlap. These enlargements are somewhat soft and pit on pressure. The tongue is often extensively swollen, and the animal drools and slobbers because of the irritation to its tongue and throat. There may be difficulty in breathing, depending on the degree of involvement of the air passages and of the lungs. Occasional coughing may occur. Muscular trembling may be evident. There may be a blood-stained discharge from the nostrils, and strings of mucus may hang from the mouth. Examination of the nostrils often reveals the presence of many small hemorrhages just beneath their lining membranes. The eyelids become highly inflamed and as a result tears flow down the cheeks.

There is an intestinal form in which the changes are chiefly found in the abdominal cavity, or the intestinal form may develop after the disease has appeared in the lungs. The stomach, intestines, and kidneys and the lymph glands belonging to them become studded with hemorrhages of various sizes, and the intestines become intensely inflamed. The consequence of the developments is that diarrhea sets in, accompanied with the passage of shreds of mucus and of bloody feces. The intestinal form is rare, as most cases show severe involvement of the lungs and the symptoms of croupous pneumonia. The animals may stand with their forelegs wide apart in order to breathe more freely. They lose flesh very rapidly when affected with hemorrhagic septicemia, their abdomens become "tucked up," and the eyes quickly become sunken. A staggering gait, caused by the extreme weakness of the patient, is sometimes noticed.

A disease has been described under the name of septic pleuropneumonia of calves, which is a form of hemorrhagic septicemia, and is caused by the *Bacillus bipolaris vitulisepticus*. The symptoms shown by the affected calves are quite characteristic of hemorrhagic septicemia, and the post-mortem findings are also those found in that disease.

In sheep, young animals which have just been weaned are found to be most susceptible, the disease manifesting itself in an acute form. There is marked depression, high temperature, labored respiration, loss of appetite, muscular trembling, and frequently colicky pains. A subacute and a chronic form of the disease are also recognized, the latter affecting principally older sheep. Aside from the febrile changes, weakness, etc., there is noted in the subacute form a discharge from the eyes and nose which at first is serous, later becoming purulent. There may be also pulmonary impairment (pneumonia), or there may be evidence of enteritis. Occasionally the symptoms subside only to return in a more chronic form, which manifests itself principally as a chronic affection of the lungs, with gradual emaciation of the animal. Sometimes the joints are involved, swelling of the knee joints being noted in some cases.

In swine the disease sometimes manifests itself in a peracute form, the animal showing symptoms of a general septicemic condition. Red spots may be noted on various parts of the body, especially around the ears and on the neck and rump. When affected with this form of the disease the animal usually dies within a few hours after the first manifestations of symptoms. In acute swine plague the disease usually occurs as a necrotic pleuropneumonia. There is labored respiration, dry, spasmodic cough, a slimy discharge from the nose, sometimes a purulent conjunctivitis, cyanotic membranes, constipation followed by diarrhea, the feces sometimes containing blood. The animal becomes greatly emaciated and usually dies in from 1 to 2 weeks. Sometimes the acute form changes into the chronic type, in which case the acute symptoms subside, and the cough and evidence of pulmonary involvement continue for a considerable time. Progressive emaciation occurs and a chronic inflammation of the joints may develop. The animals die in from 3 to 6 weeks from complete exhaustion. Sometimes, however, the lung foci may become encapsulated, and the animals may even be fattened in spite of the condition of the lungs.

ANATOMICAL CHANGES.

Swellings will be found in the subcutaneous tissues. If these enlargements are examined they are found to consist of collections of jellylike material tinged with blood. Occasionally they are limited to a single shoulder or flank, when they may be mistaken for blackleg. The lymph glands are enlarged and are injected with blood. The mucous membranes which line the respiratory tract are similarly affected. False membranes composed of fibrinous exudate may develop in the throat. The spleen remains normal. Hemorrhages are constant in the connective tissues around the kidneys and within the walls of the intestines.

In the pectoral form the lungs are darkened in color with their fibrous tissues much thickened from the collection of bloody serum in their meshes. The diaphragm, heart sac, and heart walls show numerous bloody points and larger hemorrhages.

In the intestinal form hemorrhages into the intestines will be present and sloughing of the lining of the intestinal wall will be observed, as a result of which the intestinal contents will be wrapped in a covering of bloody mucus.

In acute forms the animals may die suddenly and the changes that are present in such cases will not be very marked. Microscopic examination of the body fluids in these cases will demonstrate the presence of numerous specific coccobacilli.

DIAGNOSIS.

Because of their acute course, high fever, and rapid termination in death, some difficulty may be experienced in distinguishing anthrax, malignant edema, and blackleg from hemorrhagic septicemia. The differentiation of hog cholera from hemorrhagic septicemia of swine also presents many puzzling points.

There may be edematous swelling of the throat or neck in either anthrax or hemorrhagic septicemia. An examination of the spleen of the affected animal will give a conclusive diagnosis, for the spleen of an animal dead from anthrax nearly always becomes acutely swollen and its pulp becomes softened. Small hemorrhages are usually present in the kidney fat in cases of hemorrhagic septicemia. Bacteriological examination will demonstrate quickly the presence of the specific organisms of anthrax or of hemorrhagic septicemia, and a test should be applied in all cases in which doubt exists. The value of a definite diagnosis will be recognized when the lasting nature of an anthrax infection and the more transitory character of an outbreak of hemorrhagic septicemia are considered.

Blackleg and malignant edema may be detected usually by the formation of gas within the swellings upon the body, and the bubbles thus developed will produce a crackling sound if the fingers are pressed over the affected area. Further, in blackleg the marked change in the affected musculature and the characteristic "rancid-butter" odor noted in cases of blackleg facilitate a differential diagnosis.

Hemorrhagic septicemia of swine, commonly termed swine plague, usually appears in the form of necrotic pleuropneumonia. The symptoms shown by the affected animal readily point to an attack of pneumonia, but the presence of roundworms in the lungs may cause identical manifestations. The long course of the latter disease should be taken as an indication that the pig is not affected with swine plague.

It is very difficult to distinguish swine plague from hog cholera. The two diseases may occur in the same animal. Should the outbreak seem to be but slightly contagious and not inclined to spread from the premises upon which it first appeared, it is probably not hog cholera, but, on the other hand, if it spreads rapidly throughout the neighborhood, it is undoubtedly due to hog-cholera infection. The presence of bipolar oval bacilli does not alone establish a diagnosis of swine plague, since those organisms are frequently found as secondary invaders in true cases of hog cholera, and again they are often present in the noses and throats of healthy swine.

PREVENTION.

Animals and fowls may be protected experimentally from contracting hemorrhagic septicemia through the use of bacterins. Cattle, sheep, swine, rabbits, and fowls, if treated with heated cultures of hemorrhagic septicemia germs obtained from animals or birds of the same species as that to which they themselves belong, will almost invariably become protected against injections of living cultures of the same germ, even though applied in comparatively large quantities. Tests made by this bureau have shown that the use of cultures from animals of another species often affords similar complete immunity. Sheep have been made immune from virulent cultures obtained from other sheep by the use of prepared cultures from cattle. Rabbits have been made resistant to hemorrhagic septicemia cultures, derived from a variety of different species of animals, by treatment with prepared cultures coming from animals of other species. They have been protected perfectly from inoculations with virulent cultures of the true *Bacillus bovisepticus* in doses four times as large as that required to produce fatal results in a rabbit receiving no previous treatment. Fowls have been protected from injections of deadly quantities of virulent fowl-cholera organisms by the use of prepared bouillon growths of the same germ, or by the use of strains of the fowl-cholera bacillus possessing but little virulence. However, when the colon or paratyphoid B group of organisms is found to be responsible for the deaths, the bacterins should include these germs.

As a result of these investigations, and of others reported in medical literature, it is customary, at the present time, in manufacturing bacterins for the protection of stock from attacks of hemorrhagic septicemia to use several cultures coming from a number of outbreaks of the disease for treating the same species of animals as that from which the cultures were obtained. For example, the bacterin for bovine hemorrhagic septicemia is being prepared from strains of the *B. bovisepticus* and not the *B. suisepticus*, or vice versa.

In the October, 1916, issue of the American Sheep Breeder, Dr. W. H. Lytle, Oregon State Veterinarian, reports very satisfactory results from vaccination with an attenuated or weakened culture of the living organism. About 3,000 sheep were treated with the material. After 48 hours subsequent to the vaccination of the flocks only nine sheep were lost, although previous to inoculation several animals died each day. Bacterins made from the killed organisms of hemorrhagic septicemia have been used also with considerable success in Oregon bands of sheep.

TREATMENT.

In most cases treatment of a fully established case of hemorrhagic septicemia in an animal of any species is quite useless. All apparently well animals should be removed from those that are sick by placing them in separate, noninfected quarters. If new cases develop among them in a few days after their removal, the healthy ones remaining should be removed again to another locality. In that way the unaffected animals soon will be out of danger of further contamination, especially if their strength has been supported by an abundance of good feed and water during the period of their separation.

DISINFECTION OF PREMISES.

Premises usually become infected with hemorrhagic septicemia by stock cattle that have recently passed through some of the larger cattle markets. Owing to this method of infection the stables and yards may not be so completely contaminated as they would be if the disease had developed spontaneously. In any event, all stables, sheds, or yards that have contained infected animals should be disinfected. The interior of the stables, especially the mangers and manure trenches, should be washed with a disinfectant, such as liquor cresolis compositus (U. S. P.) or carbolic acid, 6 ounces to a gallon of water in either case. The yards may be disinfected by the application of a solution made of 5 ounces of copper sulphate to a gallon of water. The best means of applying disinfecting solutions is afforded by the use of a spray pump such as is used in the spraying of orchard trees. All refuse and material from the stable and barnyard should be removed to a place not accessible to cattle, sheep, or hogs. The manure should be spread on fields and plowed under. A plentiful supply of light and air should be provided for the contaminated stables. Open fields or pasture lands are cleansed rapidly by the action of sunlight upon them.

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 675

Contribution from the Forest Service
HENRY S. GRAVES, Forester

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RANGE PRESERVATION AND ITS RELATION TO EROSION CONTROL ON WESTERN GRAZING LANDS.

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PURPOSE OF THE STUDY.

The aim of this bulletin is to show the relation between range preservation and erosion and its control on grazing lands in the West. It is true, perhaps, that topography, climate, and soil are the primary factors in determining erosion; but, on the lands under discussion, the combination of these factors with the vegetative cover is such that erosion is slight where the natural conditions have not been disturbed and may be made serious by any influence which upsets the balance established by nature. Grazing may become such a disturbing influence by changing or destroying the vegetative cover. Numerous instances are on record where serious erosion was unknown until the ground cover was largely destroyed. On the other hand, in localities where the destroyed vegetation has been reestablished, a few typical cases of which are pointed out in the body of the report, serious erosion has been stopped.

The data in the bulletin were obtained, for the most part, on the high summer range of the Manti National Forest in central Utah, where the conditions influencing erosion are similar to those prevailing on many of the mountain ranges in Utah, Wyoming, Idaho, Nevada, Arizona, and New Mexico, and to some extent in other western States.

To complete the study will require a number of years, but the data already available on the decrease in the productivity of the soil resulting from erosion, the increase in the difficulty of revegetating the lands as erosion and soil depletion advance, and the influence of range preservation in preventing destructive erosion are of so much importance that their publication, together with the accompanying recommendations, should stimulate closer observation on the part of those in charge of the range lands throughout the West and bring about improvements in the management of these lands, which, in view of the needs of the Nation, should not be deferred.

DAMAGE CAUSED BY EROSION.

Every drop of rain that falls on more or less exposed soil has the power of removing soil particles, and with them the soluble salts essential to plant growth. Where the vegetative cover on a watershed has been largely destroyed the washing off of the surface soil may remove infinitely more decomposed vegetable matter and soluble plant food in a single season—indeed during one violent storm—than would be deposited by the decay of the vegetation in years. More than this, the resulting erosion, with its rush of water and débris, frequently ruins the lands where the débris is deposited and puts out of commission roads, trails, power plants, and other improvements. In many localities loss of property from this source has been appalling.

The greatest damage from erosion on range lands occurs where the areas have been badly overgrazed and the ground cover destroyed or seriously impaired. Before the ranges had been overstocked and the ground cover impaired, erratic run-off and erosion were practically unknown. After the breaking up of the vegetative cover in the early nineties, however, many streams originally of steady year-long flow and teeming with trout became treacherous channels with intermittent flow through which the water from rainstorms was plunged, or rose and fell according to the size and frequency of the storms and carried so much sediment in the water that fish and similar life could not exist. (Pl. I, fig. 1.)

The damage is not confined merely to the decrease in the forage yield on the range lands eroded and to the silting over of adjoining agricultural land to which the torrential floods carried the débris;

the efficiency of the watershed in maintaining a permanent flow of irrigation water is greatly decreased.

The importance of preserving the upper few inches of soil on the high ranges, and with it the vegetative cover, in order to regulate the stream flow, to maintain indefinitely the forage crop for grazing, and incidentally to prevent destructive erosion, is not always fully appreciated by the stockman and farmer. This is more especially true in localities where there is not an ample supply of irrigation water.

In the belief that more water would find its way into the irrigation canals if the vegetative cover were appreciably thinned out, there has been a tendency in some localities toward destructive grazing. For instance, several sheep owners have expressed a desire to be permitted to graze Ephraim Canyon so closely as to pack the soil firmly and to decrease appreciably the present density of that vegetation. They believed that a large amount of the water that is returned to the air in the form of evaporation from the vegetation, as well as that held by the rich surface soil, would, by thinning out the ground cover, be made available for irrigation. While it is true that if a given canyon were grazed destructively more water would undoubtedly rush down the water channels, and as a result a greater acreage of farm land could possibly be irrigated in early spring, there would be less water for subsequent irrigation at a time when the crops were seriously in need of it. With the destruction of the vegetative cover not even the lands most advantageously situated would have the benefit of a continuous stream flow for subsequent waterings during the season when even a light irrigation might result in the production of at least an average crop. In addition an enormous acreage of choice farm land would be destroyed by sedimentation, to say nothing of the high cost of upkeep of the irrigation ditches themselves.

Most farmers and live-stock growers adjoining the National Forests who are dependent upon the watersheds within the Forests for their irrigation water are likewise dependent upon the cool summer ranges for the maintenance of their stock. To graze any portion of the range destructively defeats the necessary economic balance between the range and live stock, on the one hand, and the farm land and farm crops, on the other. Much of the agricultural land adjoining the National Forests is so remote from railroads as to make the live-stock industry a necessity in the economic harvesting and marketing of the farm crops. And aside from the loss of various public and private improvements as a result of torrential floods and sediment deposits, there would remain only a small amount of forage, mostly inferior, on the watershed after three or four seasons of

excessively heavy grazing. The farmer-stockman can not afford to do without this feed. The temporarily larger profits that might be derived from overgrazing would soon be offset by the somewhat more moderate but continued profits accrued from a stable stock industry in which the lands are grazed on the basis of a sustained yield.

If instead of grazing merely one canyon beyond its carrying capacity the entire forest unit, and, indeed, all forest land of irregular topography throughout the West were likewise grazed, untold injury to farm land and other property from destructive erosion and floods would result, a sustained stream flow would no longer exist on the watersheds, and there would be neither a normal supply of water for the irrigation of the adjoining farm lands nor of forage for the live stock on the extensive forest ranges. Without these productive elevated range lands upon which to summer the stock, homes on many farms could no longer be maintained; and it would not be long before the lands would revert to the original wild state.

Within the boundaries of the Manti National Forest of Utah there is a belt of approximately 47,000 acres of land along the east side of the divide which is badly depleted as a result of overgrazing and erosion, making necessary a regulation protecting the areas from grazing part of the year. Along the west side of the divide there is a similar belt of about the same acreage where erosion is also causing damage. These belts are practically timberless, and are of value chiefly as watersheds, from which stream flow for irrigation is supplied, and for the grazing resources which they afford. That these and similar eroded lands would originally support a cow or the equivalent in sheep on from one-third to one-fifth the acreage required at the present time is evidence of the enormous loss annually to the live-stock industry alone. The soil and plant foods on these already relatively unproductive lands continue to be carried away by the run-off following each storm; and the destruction, where well advanced, is sure to continue until preventive measures are fully established.

Typical instances of the damage caused by erratic run-off and erosion are well worth citing. On July 28, 1912, a rainstorm occurred at the head of Ephraim Canyon, on the Manti National Forest, within a belt of 2 miles and between elevations of 9,000 and 10,500 feet. There was no rain in the valley or on the mountain below, approximately, 8,000 feet. The storm of 0.41 of an inch of rain fell intermittently, but at no time with special violence, for a period of two hours. A flood of sufficient force developed to reach to the city of Ephraim, 10 miles below, covering the streets and some farm land, and filling the basements of buildings with mud and débris. Laden with silt, logs, vegetable matter, and, during the

most violent period, with rocks containing as much as 30 cubic feet of material, the flood destroyed wagon roads, trails, and water ditches.

Another typical example of flood and erosion occurred on July 30, 1912, when a flow of torrential violence originated at the head of Becks Canyon. A rain, amounting to 0.55 of an inch, the greater part of which fell within an hour, started at 11 a. m., and at 11.45 a. m. a flood was pouring out of a small side canyon which drains into Becks Canyon from an area of less than 1,500 acres, at an elevation of about 10,000 feet. This area is virtually treeless and is fan-shaped, the main drainage channel originating at the head of a steep canyon which drops into Becks Canyon at the rate of about 1,000 feet in less than a mile. The soil is of a clay-loam type, and, considering the area as a whole, is of fair depth, there being but little outcrop. The slopes are moderately gentle, and because of this fact the area had not been included in the adjacent one which was protected from grazing until late in the season. An examination after the flood showed that the soil had been very densely packed by grazing previous to the storm. The whole of this small watershed was well marked with gullies. The flood was not observed until it reached the mouth of the side canyon. Here it presented a front approximately 8 feet wide and 1½ feet high. The water was so infiltrated with sediment that it did not run but rolled over and over, picking up small rock and gravel. The flow increased to a front of from 10 to 25 feet wide and from 6 to 8 feet high. The velocity and force of the rolling mass down the steep slope were appalling. The main flow lasted approximately one hour, varying in volume as had the rain 30 minutes previous. Owing to the enormous deposits of débris, the course at the mouth of the channel changed three times. As the stream changed its course from one side to another enormous quantities of material were deposited only to be carried away later. At one time approximately 5,000 cubic feet of the bank was torn out in a few minutes as the old bed filled up with material from above. All these tons of soil, vegetable matter, and other material were carried down by the rushing water in less than two hours after the rain began to fall.

In addition to the direct loss of personal property, damage to the range itself in the way of decreased forage production and soil depletion has a most vital effect on a community. Such loss is seldom fully appreciated until the stockmen must, of necessity, limit the number of animals grazed on the lands. Following the action of a few destructive floods, the productivity of the grazing lands may be so decreased that only the more inferior drought-resistant plants will thrive. Where the farm lands, upon which supplemental winter feed is grown, are remote from shipping points, as is true of much

of the farm land adjacent to the National Forests, it is evident that the crops produced can not be marketed profitably except by feeding to live stock. Even where suitable shipping facilities exist the farm lands are of value chiefly in the production of winter feed for the live stock handled on the National Forest ranges. Thus the depletion of the range not only presupposes a decrease in the number of stock grazed but tends to unbalance the agriculture of the locality.

As the forage production on range lands is decreased as a result of erosion, the water available for irrigation purposes decreases. The surface soil, containing as it does the decomposed vegetable matter, is the chief absorbing and retaining agent of water. A series of tests to determine the water-holding power of soils at different depths was carried out by obtaining samples of a noneroded soil of limestone origin in the spruce-fir type at 10,000 feet elevation, the results of which were as follows: Water-holding capacity, from surface to a depth of 6 inches, 56.4 per cent; 6 to 12 inches, 46 per cent; and 12 to 24 inches, 32.4 per cent. The percentage of organic matter contained in the soil samples was 15.8, 11.3, and 6.8, respectively. Hence the amount of water these soils retained against the force of gravity is roughly in direct proportion to the amount of organic matter intermingled with the soil particles. In the absence of this rich sponge-like soil surface, the water is readily carried away by gravity, and the stream flow for irrigation purposes is extremely erratic and available only for a short time following rainstorms. Obviously, it is often impossible for the farmer to avail himself of this flood water for irrigation purposes for at least two reasons—the water may assume torrential magnitude and carry with it so much sediment as not to warrant its use for irrigation purposes, or owing to its unexpected occurrence the farmer may not be able to make use of it.

FACTORS DETERMINING THE AMOUNT OF ERRATIC RUN-OFF AND EROSION.

The foregoing pages are intended to point out briefly the extent, occurrence, and economic aspect of erratic run-off and erosion on range lands similar in conditions to those studied. In order to be able to offer rational recommendations as to methods of prevention and control, however, it was necessary to study more in detail the factors involved. This has been accomplished by the selection and study of two areas where floods of unusual violence have originated at various times.

In the spring of 1912 two areas, designated as A and B, as similar as possible in topographic, soil, and climatic conditions and vegetation, were selected for the study. (See fig. 1.) The areas are located in the Manti National Forest at the head of Ephraim Canyon, on the

rim of the Wasatch divide, where fan-shaped drainage basins are characteristic.

Practically all the torrential floods which are responsible for the most serious destruction of property originate near the heads of the watersheds, usually at high altitudes. On the Manti Forest the most vital part of the watershed is that lying between altitudes of about 9,000 to 10,500 feet, within what is known as the spruce-fir type.

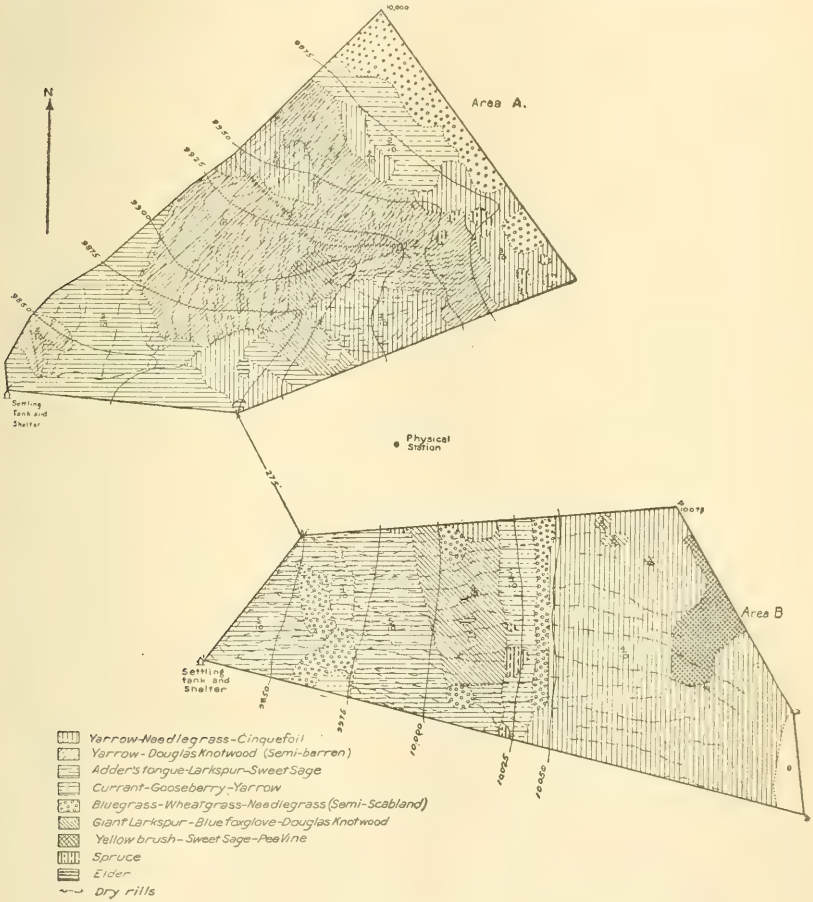

FIG. 1.—Erosion areas A and B, head of Ephraim Canyon, Manti National Forest, Utah.

It is on these elevated lands that the rainstorms are the heaviest and most violent, the slopes are steepest, and conditions in general most favorable to erosion.

The greater part of this upper mountain region consists of large fan-shaped basins which drain through narrow canyons into the valleys below. These canyons are relatively short and have a steep grade. Ephraim Canyon, for example, has an average grade of about 22 per cent, or approximately 1,160 feet to the mile. So rapid is

the drainage of water from these high basins that, in rushing through to the steep canyons, relatively little of the rain is absorbed by the soil; most of it plunges into the valleys below. Obviously, therefore, if the run-off from such areas is to be properly controlled, steps must be taken to maintain the soil cover. Unfortunately, it is these very basins that have been damaged most from overgrazing, consequently the soil and the ground cover are in the worse condition. Originally they supported a superb lot of feed especially suited to sheep, and being less broken in topography, less brushy, and more easily accessible than other parts of the range, generally they were the areas most sought for.

As is shown by the accompanying topographic and type map of the selected areas, A and B (fig. 1), seven rather distinct plant associations occur, viz: Yarrow-needlegrass-cinquefoil; yarrow-Douglas knotweed; adder's tongue-larkspur-sweet sage; currant-gooseberry-yarrow; bluegrass-wheatgrass-needlegrass (semi-scabland); giant larkspur-blue foxglove-Douglas knotweed; and yellow bush-sweet sage-peavine. The density of each of these associations is shown on the map. Most of the species are valuable as forage and as soil binders.

The soil is of limestone and sandstone origin, though chiefly the former, and varies in depth from a few inches to several feet. While there is some outcrop on both areas, the soil for the most part is fairly well decomposed. The principal drainage channels vary from 2 to 9 feet deep. In many places wherever a vegetative cover is lacking rills occur, though most of these are less than a foot in depth.

Although the two areas, as stated, are as nearly comparable as could be selected locally, yet several dissimilarities as to soil, slope, drainage, and vegetative cover occur, which occasion a much greater run-off from area A than from area B, other factors being equal. First, as shown in figure 1, area B has a vegetative cover exceeding that on area A by a density of 20 per cent. Accordingly, the soil on area B is bound together much more firmly by the plant roots than that on area A; the erosion is in a less advanced stage; and the greater amount of organic matter makes possible a greater absorption and retention of the rainfall. Area A, on the other hand, with its steeper slope lacks vegetation most where the greatest slope occurs and this tends greatly to increase run-off. Finally, area A has a different type of drainage system from area B. In cross section area A is broadly V-shaped and the main drainage is confined to one large channel running lengthwise through the area. Area B, on the other hand, is relatively flat in cross section and the drainage is divided among three principal channels. Naturally, there is more resistance to run-off which is distributed over the drainage than to run-off

thrown together into a single channel, as on area A, where the force of the water is accumulative. Thus the sum of conditions favor a larger run-off from area A than from area B. There is no permanent stream on either area, and run-off occurs only after rainstorms or from melting snow.

MELTING SNOW.[1]

The accumulation of the winter snows of 1915–16 showed a water equivalent of 9.1 inches on area A and 9.2 inches on area B. This represents approximately 326,800 cubic feet of potential water on each of the 10-acre areas awaiting the spring thaw. What becomes of the water from the melting of this snow? The water registers show that 292,998 cubic feet ran off area A, while only 42,216.8 cubic feet ran off area B. This difference in run-off is due to the fact that the soil on area B contains more organic matter and has a better ground cover than area A. A small part of the snow water, of course, evaporates into the air, but the greater portion of that not accounted for in surface run-off is absorbed by the soil. Part of the water that percolates into the soil finds its way to the main drainage channels and serves as irrigation water in the valley below; the remainder becomes an important factor in the promotion of growth of range forage. The run-off occasioned by the melting of the snow accumulated in 1915–16 caused the removal of 172 cubic feet of soil from area A as against 82 cubic feet from area B.

As might be expected, there is less sediment per cubic foot of run-off from melting snow than from summer rainstorms. Further, the total amount of sediment brought down is less than that deposited by the single rainstorm of July 21, 1915, although the stream flow from the melting snow was approximately seven times greater.

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[1] In order that the water, both from melting snow and from rainstorms, which flows from the areas may not escape through lateral rills and the record of stream flow be thus impaired, the gullies along the sides of the areas have been dammed. In order to measure accurately the run-off and sediment, a settling tank of adequate size, provided with weir and water register, has been installed at the lowest drainage point on each area. The amount of sediment deposited from each individual rainstorm and from the melting of the season's accumulation of snow is determined on the basis of the dry weight.

Owing to the intimate relation existing between run-off and erosion and certain climatic factors, the more important features are recorded throughout the year. Two standard rain gauges have been placed on each area. In addition, a tipping bucket rain gauge, located midway between the two erosion areas, records the amount and duration of each storm, as well as the rapidity of the rainfall. Snowfall measurements are taken at regular intervals of from 7 to 10 days throughout the winter season. In the spring before thawing occurs a detailed snow survey is again made. In this way the annual and the monthly precipitation on each area are known and the intensity and duration of the individual rainstorms accurately recorded.

The temperature and wind velocity are recorded by means of the thermograph and the anemometer, respectively, in the usual way. Temperature, like precipitation, is taken throughout the year, while the wind velocity is recorded only during the main growing season.

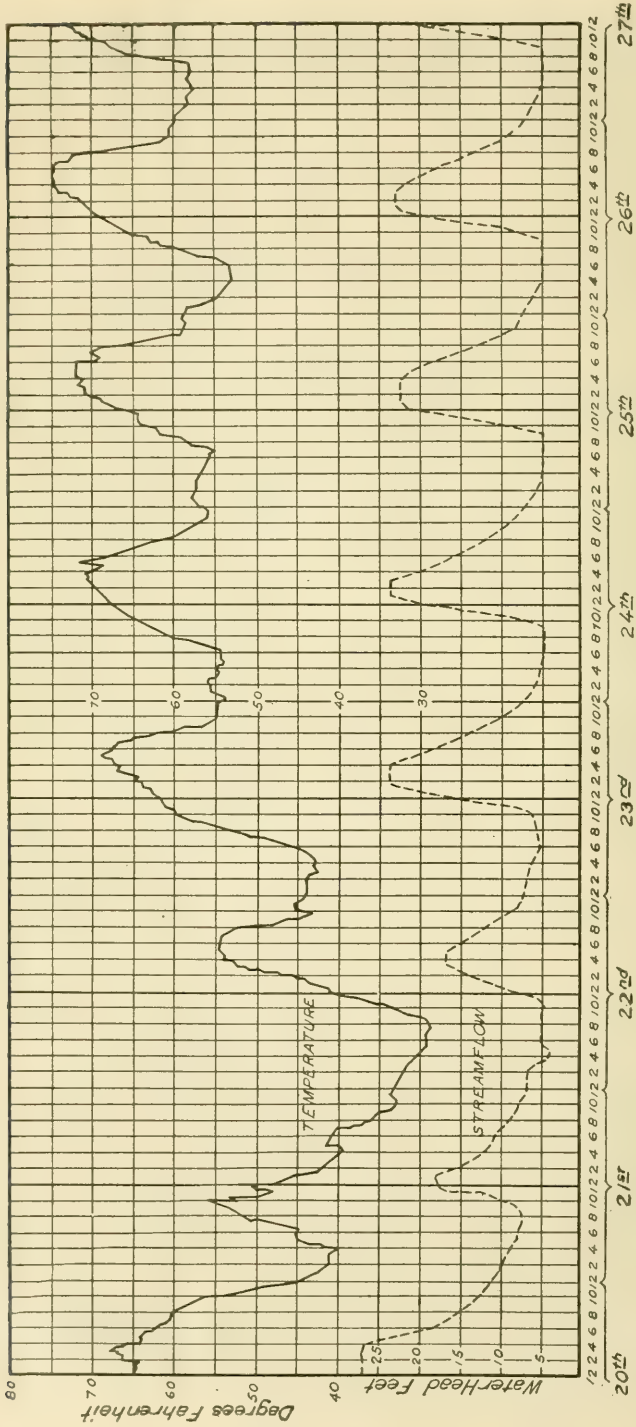


FIG. 2.—Relation of run-off from melting snow to temperature.

In correlating the meteorological data with stream flow from melting snow it was found that the stream flow follows very closely the fluctuations in temperature. The relative behavior of these factors is shown in figure 2. The flow increases with the rising temperature of the day and reaches the maximum at practically the same time that the mercury is at the highest point. The flow practically ceases between 8 p. m. and 10 p. m. and remains practically at zero during the cooler hours of the night, only to rise again with the increased temperature of the following day. High winds are found greatly to increase the rate of evaporation of the snow cover, but they affect the run-off relatively little.

Any medium, such as an effective vegetative cover, which serves to insulate the heat from the snow cover, breaks the effect of high, dry winds, and at the same time intercepts the run-off more or less, will tend to conserve the snow, regulate run-off, and make possible the absorption of a larger amount of water. This fact has been demonstrated on the wooded portion of the selected areas as well as on the extensively denuded, sparsely vegetated, and timbered lands on the forest generally.

To sum up the facts concerning the action of melting snow: Erosion from melting snow is a more serious factor than generally supposed when the vegetative cover is sparse and the slope steep. Both run-off and erosion from melting snow vary in intensity more or less directly with the character of certain climatic factors, especially temperature. In general, the soil is not frozen under a cover of a few inches of snow if the latter falls before cold weather early in the winter; so whenever melting takes place erosion may occur unless the soil is held firmly in place. The most rapid melting of snow and the most serious erosion occur where there is a lack of vegetation. In general, snow lies the longest on timbered lands.

RAIN.

An examination of the accompanying tables showing rainfall and the resulting run-off, or lack of it, disclosed several interesting facts. In the first place, out of the 26 rainstorms for the year 1915 (Tables 1, 2, 3), distributed over the four months from June to September, inclusive, only one storm—that of July 21—produced run-off. At this time, according to the record of the four rain gauges, 0.70 and 0.71 of an inch of rain fell on area A and 1.48 and 1.38 on area B, within a period of 65 minutes. From area B the run-off was 335 cubic feet and it carried 94 cubic feet of air-dry sediment, as compared to 3,019 cubic feet of run-off on area A and 717 feet of air-dry sediment (fig. 3). It should be kept in mind that the run-off from area A was enormously greater than on area B in spite of the

fact that area A received less than one-half as much rainfall as area B.

The other 25 rainstorms of the year 1915, with the possible exception of one or two in June, produced no run-off, because they were of a much gentler nature, so that the soil was able to absorb the moisture as it fell. Exception is made to certain storms occuring during June, since there was at that time a continual flow from the melting

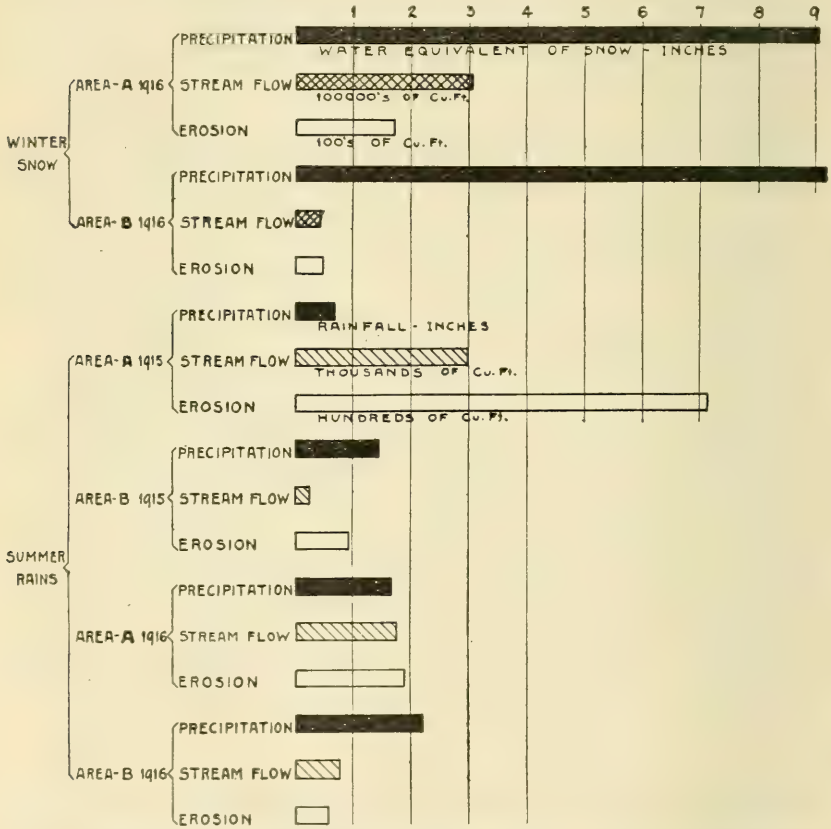


FIG. 3.—Erosion and run-off from melting of accumulated winter snow and from rainstorms.

of snow on the areas. The effect of rainfall upon the stream flow during the presence of melting snow could not be ascertained.

On July 4 a fall of 0.36 and 0.34 of an inch, respectively, were recorded from the two rain gauges on area A, and 0.43 and 0.40 of an inch on area B, over a period of 3 hours and 25 minutes. This resulted in no run-off. On September 2 and 3 there was a fall of 0.65 and 0.65 of an inch on area A and 0.62 and 0.63 of an inch on area B, covering a period of 8 hours and 45 minutes. This produced no run-off. These latter two cases, in which the rain fell at an

average rate of from 0.08 to 0.10 of an inch per hour, represent the rapidity of rainfall characteristic of the storms throughout the season. As a rule, storms as mild as this have little effect in causing run-off or erosion.

During the rainy reason of 1916 conditions were somewhat different from those of 1915. There were several storms covering periods of from two to five days successively. Naturally, storms of such duration have a greater effect in causing run-off than short mild storms. It was found that the rain for a time, depending upon the prior condition of the soil as to dryness and compactness, was absorbed and there was no surface run-off whatever; but after the soil became completely saturated and the rainfall still continued, run-off occurred and with it was carried a large amount of sediment. (Pl. I, fig. 1.)

TABLE 1.—*Rainfall on erosion areas, season 1915.*

Date.	Area A.		Area B.	
	Upper gauge.	Lower gauge.	Upper gauge.	Lower gauge.
June 1	0.75	0.75	0.75	0.75
June 2	.25	.25	.25	.25
June 3	.12	.12	.12	.12
June 6	.95	.95	.95	.95
June 9	.02	.02	.02	.02
June 13	.03	.03	.03	.03
	2.12	2.12	2.12	2.12
July 4	.36	.34	.43	.40
July 21 [1]	.70	.71	1.48	1.38
July 23	.04	.04	.04	.04
July 24	.10	.10	.09	.10
July 25	.15	.13	.12	.12
July 26	.07	.07	.07	.07
July 27	.11	.11	.11	.11
	1.53	1.50	2.34	2.22
Aug. 5	.01	.01	.01	.01
Aug. 6	.10	.08	.09	.01
Aug. 14	.01	.01	.01	.01
Aug. 16	.22	.20	.14	.16
Aug. 24	.02	.02	.02	.02
	.36	.32	.27	.30
Sept. 2	.15	.15	.13	.13
Sept. 3	.65	.65	.62	.63
Sept. 4	.11	.12	.10	.09
Sept. 7	.05	.05	.05	.05
Sept. 8	.26	.21	.32	.27
Sept. 11	.18	.18	.18	.18
Sept. 13	.03	.03	.02	.02
Sept. 25	.39	.29	.36	.44
Total	1.82	1.68	1.78	1.81
Total for the four months	5.85	5.62	6.51	6.45
Average	5.79		6.48	

[1] This was the only storm of the season to produce run-off.

TABLE 2.—*Precipitation record on erosion areas, 1916.*

Character of precipitation.	Duration of storm.						Area A.		Area B.	
	Beginning.			Ending.			Upper gauge.	Lower gauge.	Upper gauge.	Lower gauge.
	Month.	Day.	Hour.	Month.	Day.	Hour.				
Snow, 4 inches.	May	20	8.30 a.m.	May	20	1.00 p.m.	0.84	0.93	0.58	0.59
Snow, 2 inches.	June	21	10.00 p.m	June	22	3.00 a.m.	.01	.01	Trace.	.01
Rain	July	7	6.30 p.m.	July	7	9.30 p.m.	.06	.06	.06	.06
Do	do	8	2.00 p.m.	do	8	3.30 p.m.	.04	.03	.03	.02
Do	do	9	3.30 p.m.	do	9	5.00 p.m.	.03	.03	.03	.02
Do	do	14	6.30 a.m.	do	14	1.30 p.m.	.07	.09	.11	.09
Do	do	15	12.00 m.	do	15	2.30 p.m.	.12	.13	.10	.10
Do	do	16	10.30 a.m	do	16	12.00 m.	.31	.36	.32	.32
Do	do	21	7.15 p.m.	do	21	8.30 p.m.	.16	.16	.16	.17
Do	do	24	12.45 p.m	do	24	5.45 p.m.	.27	.27	.27	.27
Do	do	25	8.15 a.m.	do	25	2.45 p.m.	.30	.30	.30	.30
Do	do	26	7.45 a.m.	do	26	9.15 a.m.	.16	.12	.39	.31
Do	do	26	4.30 p.m.	do	26	5.00 p.m.	.07	.07	.08	.08
Do	do	27	6.15 a.m.	do	27	6.45 a.m.	.06	.07	.07	.07
Do	do	27	11.30 a.m	do	27	4.00 p.m.	.15	.15	.25	.20
Do	do	31	12.55 p.m	do	31	1.40 p.m.	.10	.14	.16	.15
Do	August	1	4.05 p.m.	August	1	6.30 p.m.	.04	.04	.04	.04
Do	do	2	11.40 a.m	do	2	12.00 m.	.29	.32	.38	.39
Do	do	2	9.45 p.m.	do	2	10.45 p.m	.15	.16	.28	.24
Do	do	3	11.15 a.m	do	3	11.25 a.m	.04	.04	.09	.06
Do	do	4	1.00 p.m.	do	4	2.30 p.m.	.09	.08	.10	.09
Do	do	5	12.20 p.m	do	5	3.40 p.m.	.25	.25	.28	.27
Do	do	7	11.50 a.m	do	7	1.00 p.m.	.05	.05	.06	.05
Do	do	7	6.35 p.m.	do	7	6.45 p.m.	T.	T.	.01	.01
Do	do	12	11.10 a.m	do	12	10.30 p.m	.55	.57	.54	.53
Do	do	16	6.45 a.m.	do	16	10.00 a.m	.07	.07	.08	.06
Do	September	2	1.40 p.m.	September	2	4.00 p.m.	.12	.12	.13	.12
Do	do	8	2.15 p.m.	do	8	4.10 p.m.	.10	.08	.13	.11
Hail	do	9	7.30 a.m.	do	9	10.15 a.m	.14	.17	.18	.12
Snow	do	22	5.00 p.m.	do	22	10.30 p.m	.15	.14	.17	.15
Rain and snow	do	30	11.00 p.m	October	1	4.00 a.m.	.45	.52	.61	.64
Snow	October	6					.83	.83	.83	.83
Do	do	10					.48	.48	.48	.48
Do	do	11					.06	.07	.06	.07
Do	do	15					.64	.87	.64	87
Do	do	20					.17	.20	.17	.20
Total							7.42	7.98	8.17	8.09
Average							7.70		8.13	

TABLE 3.—*Erosion and run-off records, 1915 and 1916.*[1]

Area.	Date.	Character of storm.	Precipitation.	Run-off.	Erosion.
			Inches.	*Cubic feet.*	*Cubic feet.*
A	July 13, 1915	Winter snows	(2)	(2)	230.91
B	June 29, 1915	do	(2)	(2)	184.82
A	July 21, 1915	Rain	0.70	3,018.96	716.92
B	do	do	1.43	335.15	94.29
A	July 8, 1916	Snow	9.10	292,998.19	172.36
B	June 15, 1916	do	9.20	42,216.75	82.62
A	July 16, 1916	Rain	.34	114.76	8.45
A	July 24, 1916	do	.27	100.80	
A	July 26, 1916	do	.14	86.40	
A	do	do	.07	108.00	19.30
A	July 27, 1916	do	.06	41.76	
A	do	do	.15	86.40	
A	Aug. 2, 1916	do	.30	608.68	105.54
B	do	do	.38	257.15	26.34
A	do	do	.15	37.44	4.54
B	do	do	.26	80.62	8.93
A	Aug. 5, 1916	do	.25	589.96	56.52
B	do	do	.27	439.40	24.54
A	Oct. —, 1916	Rain and snow	2.32	492.48	3.14
B	do	do	2.32	58.38	0.00

[1] Only those rainstorms that produced stream flow are here given. Note that several storms produced run-off on area A but not on area B.

[2] No records.

A significant feature to be noted from the 1916 precipitation and run-off records is the fact that run-off occurred on area A as a result of storms that produced no flow from area B, in spite of the fact that area B received just as much or generally more rain than area A. Surface conditions again account for this fact.

Table 4 summarizes the rainfall for the two years 1915 and 1916 and the resulting erosion and run-off. It shows the comparative effects of gentle storms and storms of unusual violence, such as not infrequently occur in the higher mountain region of the Manti Forest. From Table 4 it is apparent that of the summer rains of 1916, totaling 7.70 inches on area A and 8.13 inches on area B, 14 storms on area A and 8 on area B were effective in producing run-off. In 1915 there was but one such storm, yet the erosion from this single storm was very much greater than from the several storms of 1916. The most significant fact shown is that the per cent of sediment carried in the run-off is proportionately higher as the velocity of the flow increases. Thus if we apply the established formula, namely, that the transporting power varies directly as the sixth power of its velocity, it is evident that if the velocity of a flow is increased two times its transporting power is increased 64 times. It is understood too, of course, that the larger the flow the greater is the velocity of that flow.

To sum up, the extent of erosion and run-off depends upon (1) the rate at which the rain falls, (2) the steepness of the slope, (3) the presence of well-established gullies, (4) the character of the soil, and (5) the density and character of the vegetation.

TABLE 4.—*Run-off and erosion from rainstorms.*

Year.	Area.	Total number of storm days.	Total rainfall.	Effective[1] storm days.	Effective[1] rainfall.	Run-off.	Sediment.	Sediment.
					Inches.	*Cubic feet.*	*Cubic feet.*	*Per cent.*
1915	A	26	5.79	1	0.70	3,018.96	716.92	23.70
1915	B	26	6.48	1	1.43	335.15	94.29	28.13
1916	A	36	7.70	14	4.05	2,266.68	197.49	8.70
1916	B	36	8.13	8	3.23	835.55	59.81	7.20

[1] Effective here refers to storms that produced run-off.

WIND.

In addition to the conspicuous action of the gully or shoe-string type of erosion described above, erosion caused by the action of the wind more or less uniformly over the soil surface is a factor of high importance in determining the fertility of the soil under certain conditions.

Following the destruction of the vegetative cover, either entirely or in part, the wind movement becomes particularly active in the

translocation of soil. In practically all regions wind is sufficiently strong to cause soil particles, not firmly bound by vegetation, to be carried from one place to another and subsequently to be transported downward by water. On elevated lands enormous quantities of soil are often carried away, not uncommonly causing uniform removal of several inches of the surface soil (Pl. I, fig. 2). This is in part due to the sparseness of the vegetative cover, especially of tree growth, and its failure to break the wind. On the more elevated lands the vegetation is usually less dense than at lower altitudes, so that the wind has considerable more effect and its velocity is considerably greater, as Table 5 shows.

TABLE 5.—*Monthly wind movement in miles in the spruce-fir type (elevation 10,000 feet) and in the aspen type (elevation 8,500 feet).*

Month.	Year.	Aspen.	Spruce-fir.
		Miles per month.	*Miles per month.*
June	1915	3,081	6,501
	1916	3,020	7,119
July	1915	3,055	6,807
	1916	3,697	5,505
August	1915	3,339	4,836
	1916	3,198	5,116
September	1915	3,008	7,632
	1916	3,080	6,873
Total	1915	12,483	25,776
	1916	12,995	24,613

Considering the two locations month by month for the period given, it is evident that the wind movement during the growing season, which is practically the only time when the soil is exposed and subject to wind erosion in the higher type, is approximately 100 per cent greater in the heart of the spruce-fir type at 10,000 feet elevation than in the aspen type 1,500 feet below.

In order to show more in detail the periodic behavior of the wind during the season when the soil is exposed and subject to movement by the wind, the maximum and average wind velocities recorded in 1916 have been summarized by 10-day periods. The results are given in Table 6.

TABLE 6.—*Maximum and average wind velocities (miles per hour) summarized by 10-day periods, season 1916.*

Type.	Wind.	June.			July.			August.			September.		
		1–10	11–20	21–30	1–10	11–20	21–30	1–10	11–20	21–30	1–10	11–20	21–30
Aspen, elevation 8,750 feet.	Maximum	13	9	9	20	18	17	17	14	10	14	12	12
	Average	4.5	5.9	4.1	5.1	4.2	5.6	5.0	4.3	3.7	5.0	3.8	4.0
Spruce-fir, elevation 10,000 feet.	Maximum	27	26	24	17	18	12	21	22	19	34	16	33
	Average	10.3	9.3	9.6	8.2	7.3	7.1	9.5	8.2	6.7	12.5	6.6	9.9

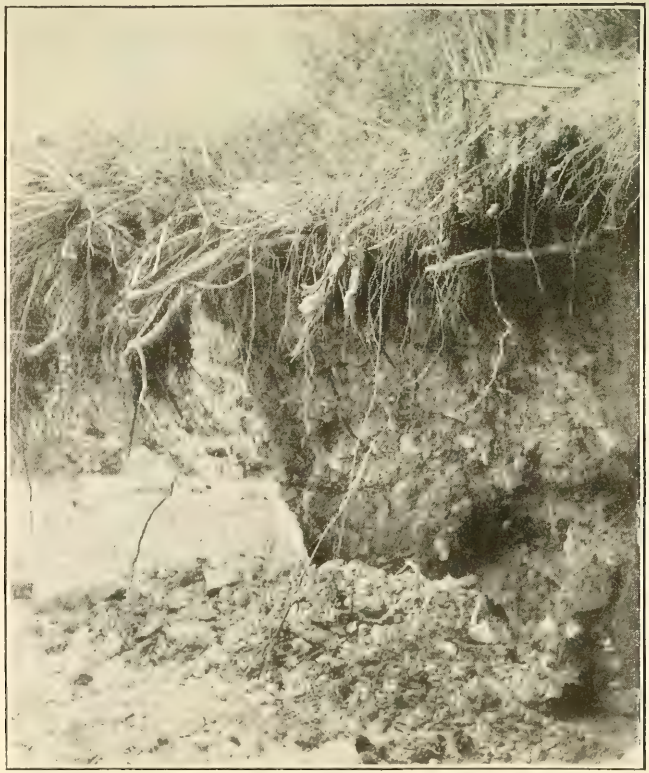
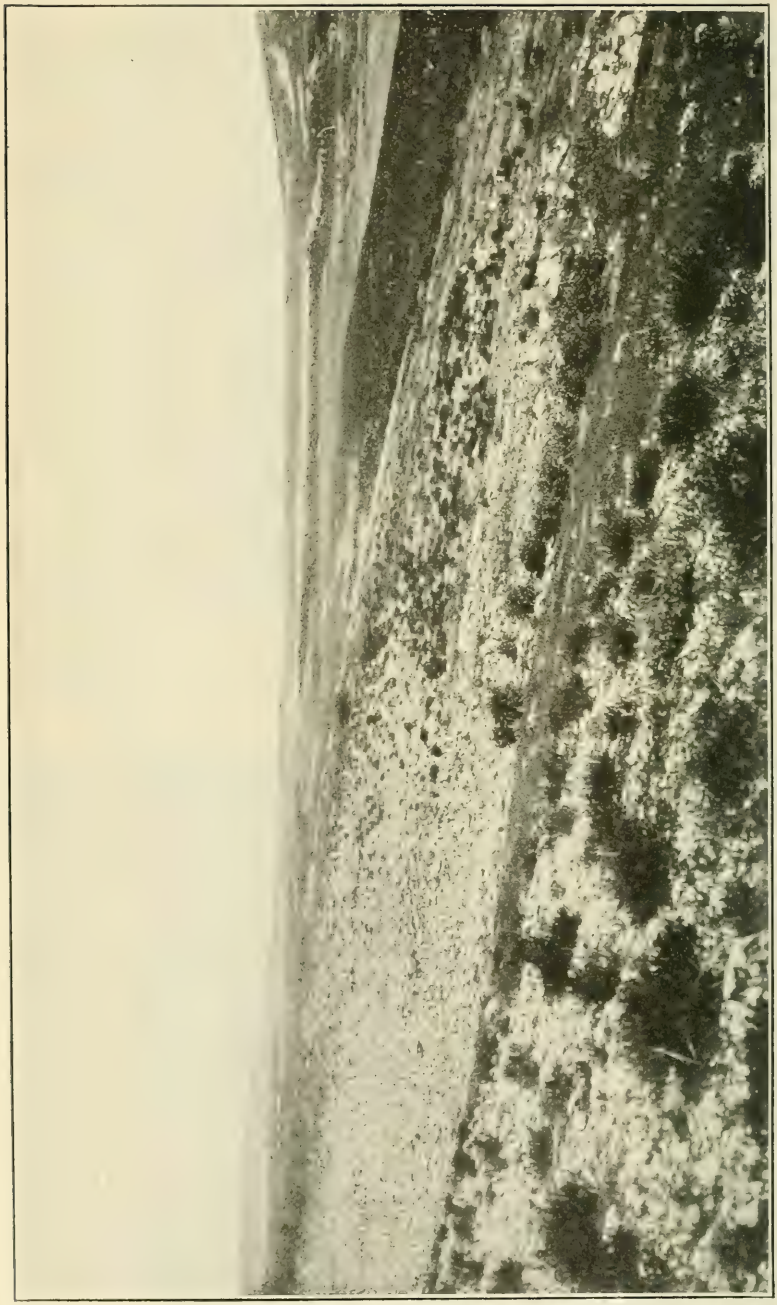


FIG. 1.—UNDERMINING OF EPHRAIM CREEK DURING A TORRENTIAL FLOOD.

Following practically every rainstorm causing erratic run-off of any consequence, parts of Ephraim Creek, near the foot of the mountain where the force of the water is greatest, are undermined and the banks cave in. Most of the loosened silt and rocks are carried down to the valley by subsequent storms.

FIG. 2.—RANGE LAND STRIPPED OF ITS GOOD SOIL.

The remaining grass hummocks mark the depth to which the rich surface soil has been removed in a sheet by wind and water erosion.



RESULTS OF SHEET AND WIND EROSION NEAR TIMBER LINE.

The protective vegetation has been partly removed and the fertility of the soil so seriously impoverished by erosion that few species of plants are hardy enough to establish themselves. It will require decades to revegetate such lands thoroughly.

The above summations show clearly that the maximum velocity of wind in the spruce-fir type exceeds by about 200 per cent that in the aspen type at certain periods. These gales on the elevated plateaus, especially where the ground cover is sparse, have a marked effect on the movement of the soil and without doubt are an important factor in causing erosion when the surface soil is dry and exposed (Pl. II). It is especially important, therefore, that the vegetable cover on these elevated lands be maintained in a maximum state of density in order to bind the soil firmly.

VEGETATIVE COVER.

While the foregoing data indicate that the extent of surface run-off and erosion are determined by the combined action of a number of factors, the vegetative cover is the most important single controllable factor under the conditions in question. Man has little control over climate and topography, and improvement in soil conditions most favorable to the control of erosion on the range lands under discussion must be accomplished chiefly through the improvement in the vegetative cover. Even this possibility of control is limited primarily to what can be accomplished by management of the lands so as to favor the development of the native vegetation to the greatest possible extent because western range conditions in general are not favorable to the planting of cultivated species. This importance of the native vegetative cover in maintaining conditions unfavorable to erosion may be considered both a drawback and an advantage, for, on the one hand, certain precautions must be taken in harvesting the forage crop in order to preserve and maintain the vegetation; but on the other hand, there are relatively few lands which, under proper management, can not be revegetated enough so that serious erosion and destructive floods may be prevented.

Anybody on a virgin or completely vegetated range during a heavy rainstorm can not fail to notice to what a great extent the vegetation, whether grass, weed, browse, or timber, protects the soil and increases its power of soaking up the water. Instead of the entire force of the rain falling on an unprotected and exposed soil surface, as in the absence of vegetation, the rain is intercepted more or less by the vegetation, so that by the time the water reaches the soil surface its original force is broken. There are several reasons why a well vegetated surface offers the best condition for absorption and underground storage of water. The foliage and stems of the vegetation form a storage place from which water drips slowly to the ground for considerable time after each rain; and the leaves and stems, in a more or less advanced stage of decay, absorb mois-

ture with each heavy rain and tend to hold the water back. The records taken on the selected areas in connection with the run-off and erosion from melting snow showed clearly that the snow lies longer under a vegetative cover than in the open, and more water is therefore available for absorption by the soil in the spring of the year in the presence of a good plant cover. Aside from the vegetation protecting the snow from the direct rays of the sun, the roots create minute channels for the ready entrance of water into the earth. To destroy this vegetative cover as shown in Plate III, then, is to decrease materially the power of absorption of the soil.

The soil on fully vegetated lands contains a much larger amount of organic matter than on denuded areas and this greatly increases both the water-holding capacity of the soil and its power of absorption. Accordingly, on fully vegetated lands there is practically no erosion except during violent rainstorms of short duration or after prolonged heavy rains, and even then the erosion is seldom serious. On denuded or sparsely vegetated slopes, on the other hand, run-off and erosion may occur after very small rainstorms.

RELATION OF EROSION AND SOIL DEPLETION TO VEGETATIVE GROWTH.

It has long been known that different plant species may exhibit a great difference in the amount of water required in various soils to produce a unit of dry matter, a function of profound economic importance in the agricultural development of a region of limited rainfall. Carefully conducted experiments have also proved that when certain fertilizers are added to a soil lacking in plant foods the amount of water evaporated from a plant in the production of a unit of dry matter is considerably reduced, and that the stand of vegetation may be dense or sparse according to the fertility of the soil.

In view of these facts, it seemed probable that the sparseness of the native vegetation generally observed on lands whose soils have been subject to more or less serious washing and leaching for a number of years, the short stature of the plants, and the virtual lack of seed production, might be accounted for by the low fertility of the soil and lack of sufficient moisture coupled with a relatively high water requirement of the vegetation in the production of growth.

In order to determine the difference, if any, in the potential crop production and water requirement of plants grown on eroded and noneroded soils, samples of identical origin and type were selected for comparative study. The soils in question were selected in the spruce-fir type on typical summer sheep range at approximately 10,000 feet elevation. After being carefully sifted and thus freed of the larger pebbles, etc., the soils were moistened moderately and

tamped firmly in cans 14 inches wide and 17 inches high. Six large test pots were used, three of which contained eroded and three noneroded soil, and each was planted to five seedling plants as follows: One set, consisting of one pot of eroded and one of noneroded soil, to a pedigreed field pea known as Kaiser variety; one set to native bromegrass, locally called wild oats (*Bromus marginatus seminudus*); and the third set to a pedigreed wheat known as Kubanka No. 1440.

The pots were hermetically sealed and so arranged that all the water loss from the soil had to pass through the plants in the form of transpiration or evaporation. The pots were weighed at regular intervals and water was added to the soil so that the moisture content was kept practically constant. Throughout the experiment the average moisture content was about 30 per cent, a supply ample to produce the most vigorous growth on both soil types.

Owing to the action of the elements on the two soils studied there was an interesting and significant difference both in their chemical and physical properties. The percentages of salts important to the growth and development of plants in these soils are as follows:

TABLE 7.—*Salts important to the growth and development of plants on the two soils studied.*

Soil.	Lime (CaO).	Potash (K_2O).	Phosphoric acid (P_2O_5).	Total nitrogen.	Loss on ignition (humus).
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Eroded	1.26	1.53	0.22	0.156	6.64
Noneroded	1.49	1.30	.33	.488	14.65

In all the constituents considered except potash, the noneroded soil is much the richer. The greatest difference is found in the total nitrogen content, one of the most important of plant foods. This is due to the fact that a large proportion of the nitrogen compounds are more or less soluble in water and consequently had been largely washed out of the eroded soil.

The chief physical properties are those which affect the total water-holding capacity of the soils and the amount of water that can be absorbed from them by a plant. These properties are intimately associated with the amount of organic matter in the soils. The eroded soil was found to have a maximum water-holding capacity of 46.8 per cent as compared with 67.2 per cent in the case of the noneroded soil. At the same time the soil moisture which can not be absorbed by the root hairs of the plant, and which is therefore termed "non-available" water, was found to be 15.6 per cent in the eroded soil and 19.3 per cent in the noneroded soil. Owing to this the combi-

nation of higher water-holding capacity and higher percentage of available water when the soils are saturated there remains for the plant 16.7 per cent more water in the noneroded than in the eroded soil.

Tables 8 and 9 and figures 4 and 5 summarize the results as to vegetative growth and the water requirements of field peas, native bromegrass, and cultivated wheat grown in the two soils. In the case of each of the three plants the table shows that a much greater amount of water was required for the production of a unit of dry matter in eroded than in noneroded soil.

TABLE 8.—*Pounds of water required by peas, bromegrass, wheat, and wheat heads per pound of dry matter produced.*

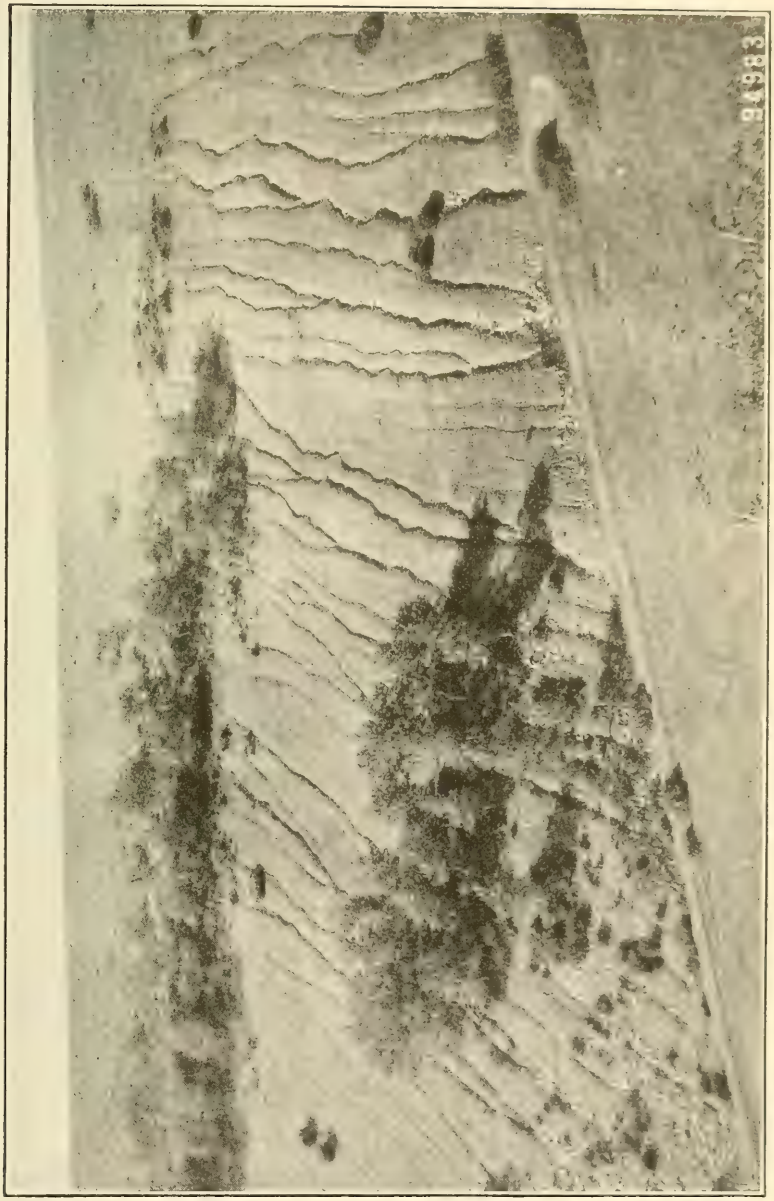
Soil.	Peas.	Brome grass.	Wheat.	Wheat heads.
Eroded	841	1,339	472	1,370
Noneroded	467	1,110	343	407
Per cent difference	80.3	20.6	37.6	2.66.

TABLE 9.—*Summary of vegetative growth and water requirements of peas, bromegrass, and wheat.*

Plant and soil.	Number of leaves.	Leaf length.[1]	Dry weight.	Water used per plant.	Water used per pound dry matter produced.
		Millimeters.	*Pounds.*	*Pounds.*	*Pounds.*
Peas:					
Eroded soil	42	791	0.79	667	841
Noneroded soil	712	2,634	6.55	3,051	467
Native bromegrass:					
Eroded soil	35	2,902	.41	553	1,339
Noneroded soil	84	5,218	.85	944	1,110
Wheat:					
Eroded soil	22	4,474	5.52	2,516	472
Noneroded soil	47	10,080	12.09	3,820	343

[1] In the case of peas the length of stem is given instead of the leaf length.

Figure 5, summarizing the vegetative growth and water requirement of peas on the eroded and noneroded soil, shows a remarkable contrast in the vegetative growth and other activities. The number of leaves is as 1 to 2.7; the leaf length, 1 to 3.3; the total dry weight produced, 1 to 8.3; and the water used per plant, 1 to 4.6, all in favor of the noneroded soil. In the water requirement per unit of dry matter, on the other hand, the ratio is reversed, being as 1.8 to 1 on the eroded and noneroded soils, respectively. Hence there are a great many more leaves, greater stem and leaf length, and more dry matter produced on the noneroded than on the eroded soil, with a notably smaller amount of water (Pl. IV). The latter fact, of course, is ac-



OVERGRAZING A COMMON CAUSE OF SOIL WASHING.

The original vegetation has been almost wholly removed as a result of too heavy grazing followed by drying and leaching of the soil. If grazing, especially of sheep, is not discontinued, revegetation can not be expected.

THE MEANING OF SOIL EROSION.

Canadian field peas (left) grown in poor or eroded soil and (right) in good mellow soil of the same type which has not been subjected to erosion.

counted for by the more luxuriant growth of the individual plants on the noneroded soil regardless of the smaller amount of water required for the production of a unit of dry matter.

In the case of native bromegrass and wheat the same behavior holds as to vegetative growth and other facts as in the case of the peas. Hence 2.4 and 2.1 times as many leaves of bromegrass and wheat, respectively, were produced on the noneroded as on the eroded soil; the leaf length, dry matter, and water used per plant

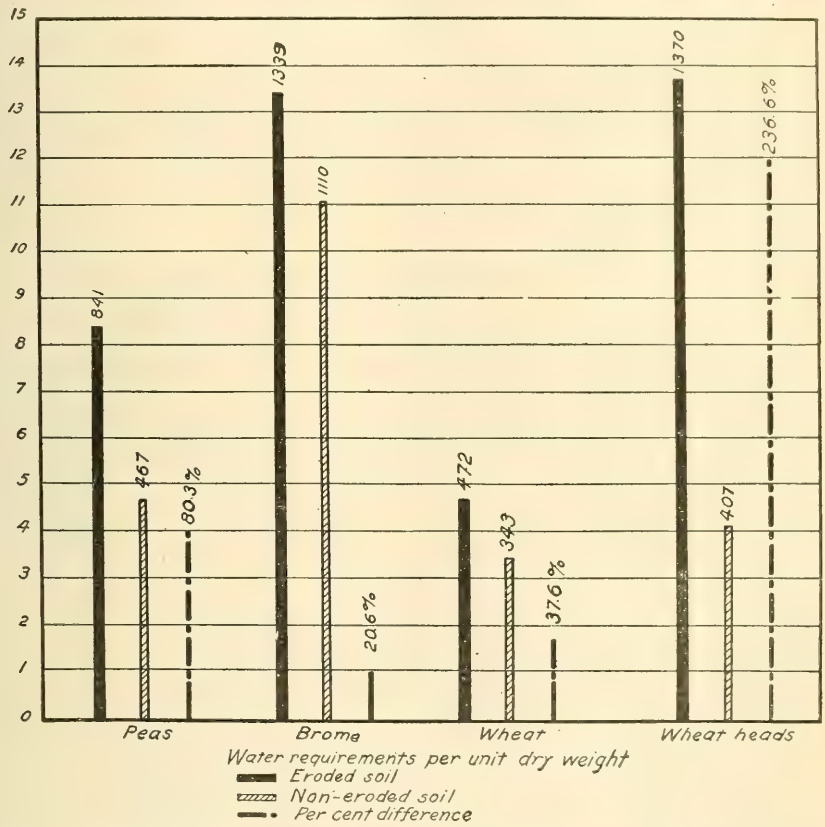


FIG. 4.—Relative water requirements per unit dry weight for peas, native bromegrass, and wheat grown in eroded and in noneroded soils of the same type.

were greater on the noneroded soil by 0.8 and 1.3, 1.1 and 1.2, 0.7 and 0.5 for native bromegrass and wheat, respectively. And here, again, the water requirement per pound of dry weight was greater on the eroded soil by 20.6 per cent and 37.6 per cent for the native bromegrass and wheat, respectively.

Erosion is detrimental to plant growth chiefly because it brings about the two following conditions of soil impoverishment: (1) Lack of adequate soil moisture for the full development and seed

production of the vegetation due to the lowered water-holding capacity of the soil, and (2) lack of adequate plant nutrients in the soil for good growth due to reduction of the soluble plant foods.

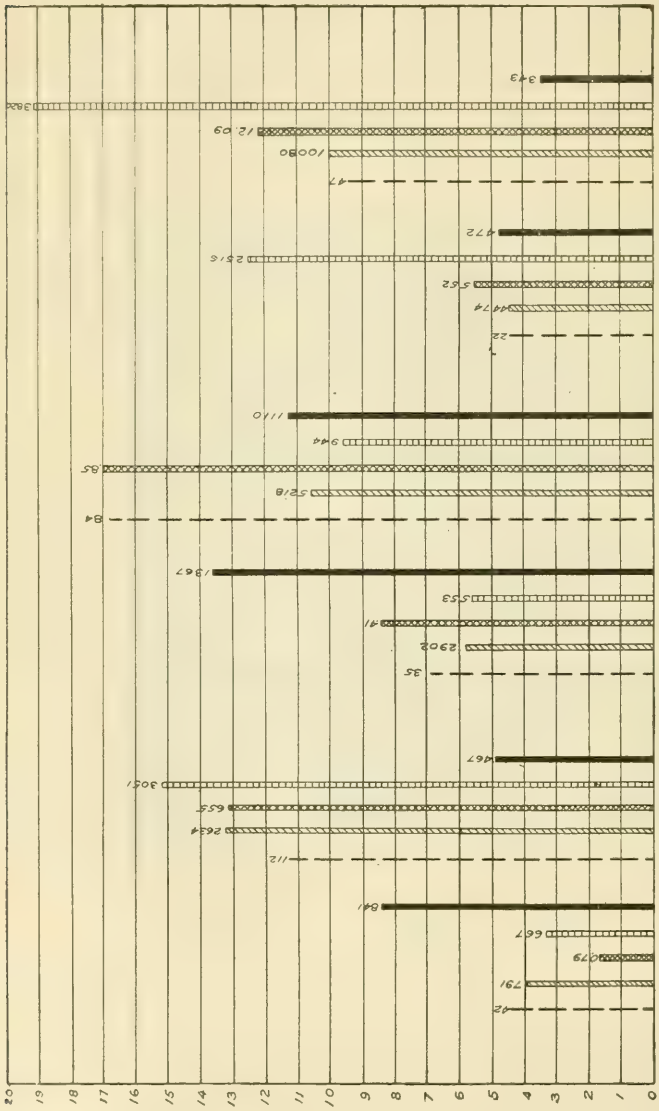


FIG. 5.—Summary of vegetative growth and water requirement of peas, native bromegrass, and wheat in eroded and noneroded soils.

RELATION OF EROSION AND SOIL DEPLETION TO REVEGETATION.

The establishment on eroded soils of a dense vegetative cover made up of desirable forage and other deep-rooted, soil-binding species, similar to the original type, is a most difficult task. In the first place,

owing to the low moisture content due to exposure and lowered water-holding power, seed germinate poorly. Moreover, about nine-tenths of the plants which do come up die early in the spring while still in the seedling stage. The remainder usually dry up before the end of the season.

Interesting contrasts have been recorded on the mountain ranges of the Manti National Forest as to the rate of revegetation and the character of species being established on overgrazed and subsequently eroded lands as compared with lands which have not been seriously overgrazed, and where the soil, therefore, is relatively productive. During observations extending over four years (1913–1916) it was most exceptional to find on the more seriously eroded soils an increase in the number or appearance of new deep-rooted perennial species of any kind. On the less seriously eroded soils, on the other hand, shallow-rooted perennial species, both seedlings and matured specimens have gradually increased in number each season; and on somewhat overgrazed, but not eroded lands, deep-rooted perennials have increased relatively rapidly and steadily.

On analyzing the data recorded as to the rate and character of the revegetation it was found that by noting the seriousness to which the soil has been eroded, and hence its physical condition, including the relative amount of organic matter contained in it, it is possible to predict with much precision not only the rate at which the ground cover may be restored but the particular kind of plants that will occupy the soil for a temporary period prior to establishment of a permanent vegetation. As a general thing, many years must lapse before the more desirable forage species can reoccupy the site upon which they formerly predominated. The reestablishment of the deeper-rooted perennial species, if this type of vegetation is desired, and it usually is, can be accomplished on these eroded soils under range conditions only by certain rather inconspicuous plants first gaining a foothold on the land and gradually reinstating the vegetable matter and plant foods which are invariably lacking.

The replacement of one set of plants by another through a series of successive invasions is known as plant succession. Where the fertility of the soil has been seriously impaired only rapidly growing and early maturing annual species first occupy the soil. Several species of this type of vegetation begin germination and growth promptly in the spring, and before the soil has dried out to a point where the vegetation wilts beyond recovery and further growth, the plants have developed fully and ripened an abundant seed crop of good germination strength. The ramifications of the roots of these inferior plants through the soil season after season, the aeration of the upper soil layer as a result of the innumerable penetrations

and subsequent decay of the roots; and the addition of humus to the soil by the decomposition of the portions of the plant developed both below and above ground, finally accomplish wonders in improving the physical and chemical condition of the soil, provided, of course, that serious erosion in the meantime has been checked.

As the soil is improved and absorbs and retains more water than in the beginning, the annual plants develop more luxuriantly. At this point, however, the space occupied by the annual species is gradually encroached upon by slightly deeper-rooted, more robust annual plants, usually accompanied by a few shallow-rooted biennial and perennial plants. As the fertility of the soil is further improved, even the more robust annual species disappear and the more permanent perennial type of vegetation predominates as formerly. For many years after the latter type becomes conspicuous, however, less forage is produced, and of a poorer quality for stock generally, than before the soil became depleted.

From the above facts, then, it is evident that soil depletion, as related to forage production and revegetation, does not imply merely a temporary change in the character of the vegetation and nutritiousness of the forage; on the contrary, the time element enters as a highly important consideration. To reestablish completely the more desirable and permanent species, such as occupy the soil before it becomes depleted, often requires years of time coupled with expert management. Too much care can not be exercised by the stockman and farmer in preserving the dark surface layer of soil, for that portion is the very life of any land. Preserving the surface soil in the first place is much cheaper than replacing it, and this is not a difficult matter if proper precautions are taken when incipient erosion becomes apparent.

INFLUENCE OF GRAZING ON EROSION AND STREAM FLOW.

While it is evident that the extent of run-off and erosion are roughly proportionate to the effectiveness of the ground cover in binding the soil, other factors being equal, the question as to whether run-off and erosion are augmented or retarded by grazing is one upon which opinions vary widely. Some stockmen contend that if a soil is cut up more or less by the trampling of stock, or the surface pretty thoroughly pulverized, more water will be held and subsequently absorbed by the soil than if the surface is undisturbed. Others are of the opposite opinion, contending that the packing of the soil, which unavoidably results from grazing, especially if the soil is fairly moist when stock travel over it, prevents the rain from being absorbed in maximum amounts. In carying out the details of the experiment on

the selected areas, strikingly significant results as to the effects of grazing and nongrazing were obtained.[1]

On July 21, 1915, when both areas had been protected from grazing since August, 1914, a heavy rainstorm occurred in which area B received approximately twice as much precipitation as area A: but only about one-twelfth as much run-off and one-ninth as much erosion was recorded from area B as from area A. On August 5, 1916, area B was grazed closely by sheep, area A being at that time ungrazed. Late in the day of August 5, a rainstorm occurred in which both of the selected areas received an average of 0.25 of an inch of rain. Practically the same amount of run-off was recorded

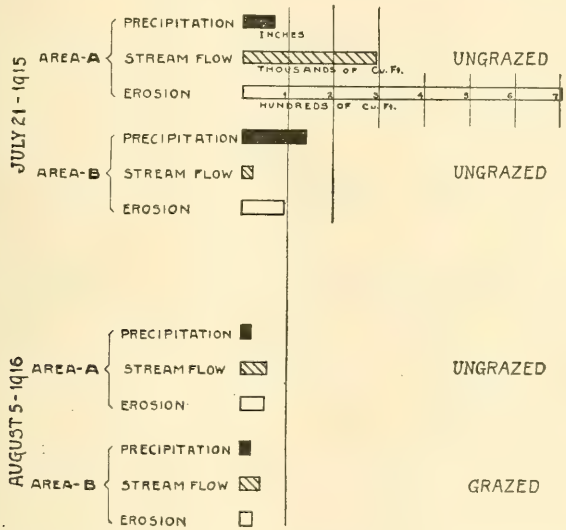


FIG. 6.—Relation of grazing and nongrazing to erosion and run-off.

from the two areas, and the erosion from area B was one-half that from area A, as shown in figure 6.

It will be noted, then, that the ratios of precipitation, run-off, and erosion on area B as compared with area A were changed from 2/1, 1/12, 1/8, respectively, to 1/1, 1/1, 1/2, respectively, as a result of grazing area B and not area A. Since grazing was the only factor changed as compared with all previous records, it appears safe to

[1] The grazing of the areas was carried out as follows: Both pastures were grazed moderately close by sheep at practically the same time in the season in 1914–1916, inclusive. The prescribed time for cropping the areas is when the forage is sufficiently developed to afford good grazing, a time which corresponds fairly closely to the grazing of the unprotected adjacent range. In case the ground is sufficiently wet to injure the vegetation seriously by trampling, or to cause harmful packing of the soil, grazing is deferred until a later date when soil conditions are normal. A band of sheep of the average size—about 2,500 head of ewes and lambs—is grazed on the areas. The sheep are allowed to graze at will, being worked over the pasture only to the extent of assuring uniform cropping. The vegetation is grazed closely but by no means destructively, the grazing corresponding in this particular to that on the adjoining range.

conclude that the change in the ratios of run-off and erosion showing a marked increase in erosion on area B was due to grazing. Instead of a large proportion of the rain being absorbed, the soil surface on area B was so hard-packed by the trampling of the stock that the run-off was appreciably increased. Much of the sediment deposited was carried directly from the gullies, a large amount of loose dirt having been worked into these depressions as the sheep traveled over them.

The example of increased erosion due to grazing as given on the selected areas under date of August 5, 1916, is merely an exact measurement of a condition which has been observed in many other cases. Excellent examples of results of varying intensity of grazing and of protection of the lands from stock have been observed on two adjoining watersheds on the Manti Forest. Until 1904 Manti Canyon flooded oftener—and the floods did more damage—than perhaps any other canyon on the entire Forest. From 1904 to 1917 this canyon has been grazed very lightly by cattle, while the adjoining canyons have been grazed fairly heavily each season. Though there is still abundant evidence of past erosion and innumerable gullies at the head of the Manti watershed, the gullies have rounded out and the soil, having assumed an angle of repose, now supports a stand of grass and weeds. The fine soil, with its increased organic matter, is so loose and mellow that a saddle horse sinks into it over his hoofs. At the head of Becks Canyon, 3 miles north of Manti Canyon, sheep have grazed each year. Instead of a loose soil it is hard-packed, the gullies are relatively deep and V-shaped instead of rounded, and they support practically no vegetation either on the sides or bottom. Each of these watersheds has been under observation during various rainstorms and the amount of precipitation received at the head of each canyon has been recorded by means of rain gauges. A rainstorm that is completely absorbed without surface run-off on the Manti drainage often produces innumerable muddy rivulets in a few minutes on the Becks Canyon drainage. It would take a very heavy rainstorm—considerably heavier than has occurred during the past eight years—to produce a flood in Manti Canyon. From Becks Canyon, on the other hand, floods have occurred as a result of 0.55 of an inch of rainfall; several floods have originated in this canyon during the past few years.

Another instance showing the relation of grazing to erosion and floods occurred August 2, 1912, in Twelve Mile and Willow Creek Canyons. A committee of sheepmen, cattlemen, and Forest officers who were inspecting the range in Twelve Mile Canyon on the day of the storm which occasioned the flood testified that these floods came from mountain areas adjoining the Manti Forest which had been used as lambing grounds for several successive years. The ob-

servers stated that the storm was uniform over the areas under protection in the Forest and on the adjoining grazed area. The small amount of run-off that occurred on the protected lands was clear and the streams were little more than normal in size; the flow from the unprotected and heavily grazed areas tore out bridges and roads and was laden with bowlders, mud, and débris. As a result of the inspection, the committee requested that the areas from which the floods originated be made a part of the Manti Forest and that grazing be discontinued until the vegetative cover could be restored.

From the above data and general observations there can be no doubt that the moderate grazing of sheep on the relatively sparsely vegetated range upon which the topography, climate, and soil are favorable to erosion and upon which erosion is at least in the incipient stage, will appreciably increase both the run-off and erosion. This increase for a given area will vary according to the closeness with which the lands are grazed and the particular methods of handling the stock. It is evident that once the vegetative cover has been broken up and the soil laid bare, grazing tends to promote rather than to retard run-off and erosion.

PREVENTIVE AND REMEDIAL MEASURES.

MAINTENANCE OR RESTORATION OF THE VEGETATIVE COVER.

The need for maintaining the vegetative cover at all times in order to prevent destructive floods and erosion, and the importance of placing the live-stock industry on a substantial, permanent basis, both so far as concerns the range forage crop and the marketing of the farm products through live stock, has been shown. It remains now to show how and to what extent the vegetation may be utilized by live stock year after year without serious destruction of the vegetative cover. The maintenance of a maximum cover of vegetation and continuance of grazing are naturally antagonistic at best, and unless certain recognized principles of range and live-stock management are put into practice there is danger of impairing the ground cover.

AVOIDANCE OF OVERGRAZING.

The first precaution is to avoid overgrazing, which can best be accomplished by accurately estimating and then adjusting the number of live stock a range unit or allotment will safely carry. Excessive grazing will first show itself in the weakened condition or disappearance of the choicest and most palatable forage plants. This is usually accompanied by the appearance of incipient gullies, followed by erosion of varying seriousness. If the carrying capacity of the lands is promptly adjusted so that there is ample feed for the stock throughout the season, the vegetative cover, provided the lands and stock are otherwise properly managed, should be maintained indefinitely.

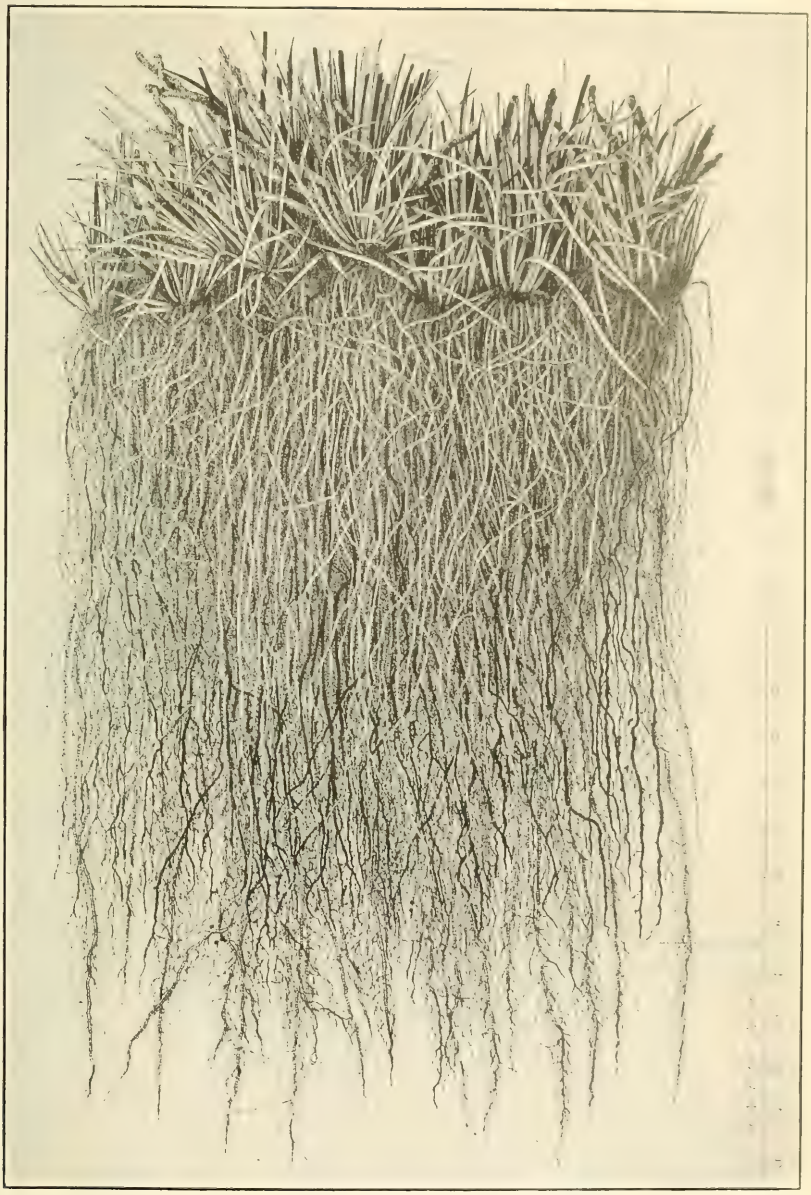
AVOIDANCE OF TOO EARLY GRAZING.

One phase of mismanagement which is often overlooked by the stockman and which is responsible for serious destruction of the vegetation, is that of permitting stock on the range too early in the spring, when the herbage is very young and succulent, and when the soil is well-nigh saturated with moisture. A week to 10 days after growth starts in the spring the forage has very little "substance" and is rather deficient in sugars and protein as compared with forage which has been growing twice as long. At no time in the season is it more essential that a plant be permitted to develop its leafage, which is the laboratory for the production of food, than early in the spring. A few days' delay in the time of grazing following the inception of growth will not only insure the production of a much larger forage crop for that particular season but in subsequent seasons as well, and the herbage will have much more strength and fattening qualities. Then, too, the bad effects of trampling over the loose, wet soil is largely avoided and the exposure of the roots and subsequent drying out of a large proportion of seedling forage plants is prevented.

THE PRACTICE OF DEFERRED AND ROTATION GRAZING.

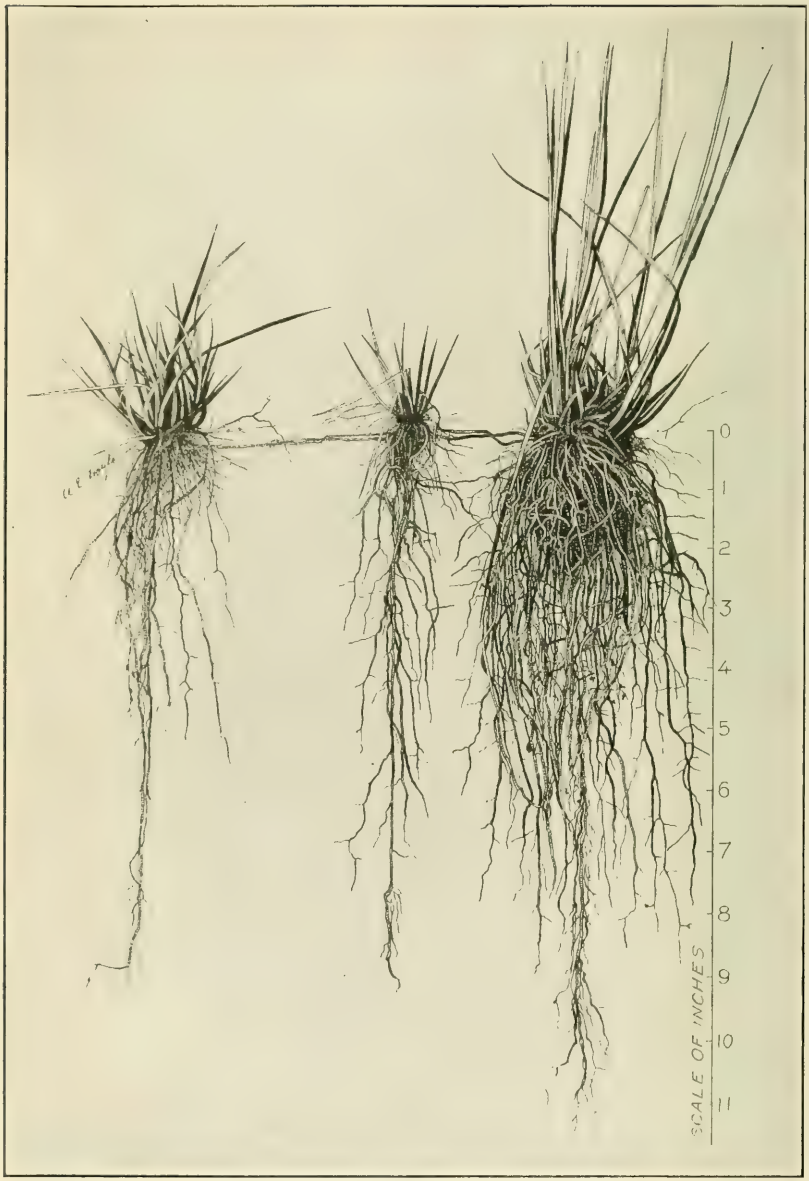
In the case of virgin range lands there will be no difficulty in maintaining indefinitely the vegetative cover provided the lands are not grazed beyond their actual carrying capacity and too early in the spring. But where the range has already been overgrazed and the original ground cover considerably thinned out, but not all of the seed plants destroyed, merely keeping the number of stock down to the estimated carrying capacity and preventing too early spring grazing are not in themselves effective means of reestablishing the desired vegetative stand. In such instances deferred and rotation grazing must be applied.

In applying the deferred system of grazing, such portion of the range as is consistent with the welfare of the range as a whole is reserved for cropping until after the maturity of the seed of the main forage species. Upon the maturity of the seed the range is grazed closely, but not destructively, by the stock allotted to the lands. The following year, owing to the large proportion of seedlings destroyed, especially on areas grazed early in the season, the forage is not to be cropped until another season's seed has been produced. If, after the production of two seed crops of the choice native forage species, an ample number of seedling plants have been established, a second area in need of seeding is selected and the tract upon which grazing was previously deferred is then grazed before seed maturity. This same plan is continued season after season, alternating the de-



TURF-FORMING GRASSES BIND THE SOIL FIRMLY.

Kentucky blue grass, where it thrives, affords excellent protection against soil washing. Being a turf-forming grass it protects the soil surface uniformly well.



UNDERGROUND PARTS OF A YOUNG GRASS.

Slender wheat grass commonly reproduces vegetatively and sends up shoots at varying intervals. Though it is a bunch grass, this species is a good soil binder.

ferred grazing first on the one area and then on another, until the entire range has been rejuvenated. After the vegetative cover has been established, however, the deferred grazing is alternated or rotated from one portion of the range to another in order to permit of the formation and distribution of an occasional seed crop by means of which the old plants may be replaced. In this way the range is brought back and maintained in its maximum state of productivity without the loss of a season's forage crop during the period required for revegetation.

ARTIFICIAL RESEEDING.

The lack of fertility and moisture in eroded soils, as pointed out, makes it necessary first to build up the depleted lands before even the most drought-resistant, well-adapted native perennial species can be reseeded. Cultivated forage plants, even of the most drought-resistant kinds, are more exacting in their requirements of plant foods and soil moisture than native species; consequently artificial reseeding can be recommended as a paying proposition only where the soil of mountain range lands is above average in fertility and where the moisture conditions are favorable to growth throughout the summer season. Incipient meadow erosion may in some instances be held back by seeding to cultivated plants of a soil-binding type, like Kentucky bluegrass, but under such conditions the scattering of a little seed of aggressive, turf-forming native species on the exposed soil is still better. (See Pls. V and VI.)

CONTROL AND DISTRIBUTION OF LIVE STOCK.

One of the most common causes of range depletion, even where the carrying capacity of the lands as a whole has been carefully estimated, the season of grazing adjusted, and the deferred and rotation system of grazing adopted, is the excessive grazing of one area and the nongrazing or very light cropping of another as the result of poor distribution of stock, improper salting, and faulty handling of the stock, especially sheep.

There is a tendency among cattle and horses to drift to and congregate on the more elevated plateaus, though the feed may be at its best at lower elevations. While they may not reach the mountain ranges for some time after growth has started, far more animals may remain on certain lands than can be grazed without injury to the vegetation. In the meantime the forage at lower elevations dries up and becomes less palatable, the temperature becomes too high for the stock to make maximum gains, and as a consequence much of the forage is wasted.

The most effective means of holding cattle and horses on the portion of the range desired, and at the same time obtaining even distribution, are properly located salting and watering places and drift fences. The salting places can be located in such a way as to compel the animals in search of salt to travel over the range lands desired. This, of course, is also true of the location of places where water is to be developed for live-stock purposes, though, of course, the latter is much more difficult to control than is the distribution of salting places. Likewise, under certain conditions, drift fences constructed in suitable places are the most effective means of protecting the range from excessive grazing and undue trampling by stock.

In the case of sheep two conditions (aside from overestimating the carrying capacity of the lands) are chiefly responsible for the destruction of the vegetative cover, (1) bedding too long in one place, and (2) too close herding and the excessive use of dogs.

Bedding sheep several nights in one place necessitates trailing to and from feed to such an extent as to uproot and destroy much of the ground cover. In addition, the bed ground itself is completely denuded of vegetation and years are required fully to reestablish the stand.

Trailing back and forth from range to an established bed ground should be replaced by the "burro" or "blanket" system of herding, that is, camping wherever night overtakes the band. Numerous sheep raisers who have abandoned the use of the regular bed ground would never think of going back to the practice, for the reason that the feed is infinitely better than formerly and because appreciably larger gains are made by the sheep. When no regular bed ground is used and the sheep are given all the freedom possible consistent with the grazing of suitable range, the band is more content and easier to handle and there are less losses from poisonous plants. At the same time the all-important ground cover is not destroyed, provided the "leaders" and "laggers" of the band are not excessively dogged and roughly handled. Often as much vegetation is destroyed through the excessive use of dogs as from overgrazing and subsequent run-off.

On lands where the sum of conditions favoring floods and erosion—such as deficient vegetative cover, steep slopes, and the presence of numerous gullies of the incipient and advanced type exist—it is the safest plan to undergraze rather than utilize the herbage so closely as possibly to injure the existing vegetation. In general, greater injury is done on such lands by trampling than by actual grazing; consequently, unless the range is excessively rough and irregular, it is often a distinct advantage to graze the lands by cattle rather than by sheep.

REMEDIAL MEASURES WHERE THOROUGH REVEGETATION BY ORDINARY MEANS IS IMPOSSIBLE.

TOTAL EXCLUSION OF STOCK.

On the more important fan-shaped basins at high elevations, where the original vegetative cover, including the seed plants, has for the most part disappeared, and where the fertility of the soil has been seriously depleted as a result of erosion, the best plan is to discontinue grazing entirely. The small amount of forage produced, consisting, as it usually does, of annual weeds and many poisonous species, by no means compensates for the further skimming off of the already deficient organic matter and tearing down into the gullies of the loose soil. In most instances stock will not have to be excluded longer than during the period required to reestablish the fertility of the soil and the incoming of the deep-rooted, permanent type of perennial vegetation, provided, of course, that light grazing and proper handling of the stock are at all times resorted to. On the other hand, where the soil fails to regain its former productivity within a reasonable length of time, as indicated by the character and density of the vegetative cover following the exclusion of stock, grazing should be permanently discontinued. To graze such lands after a few years of rest, even though they produced a little feed, would be to undo in a season all that nature has accomplished in building up the soil during the seasons that stock was excluded.

TERRACING AND PLANTING.

There are local areas, mostly of small size, where the proper regulation of grazing and, indeed, the total exclusion of stock from seriously eroded lands is delayed until the vegetative cover can not be effectively reestablished and the erosion thus eliminated. The establishment of a dense cover of vegetation should not be hoped for on the bottom and along the sides of deep, vertically cut gullies where the water rushes by after each rainstorm of appreciable size. The force of the water does not permit many seeds to lodge, and in the beginning the soil is too thin and dry to favor growth. Depressions of the more prominent gullies which have been revegetated, however, would still serve as drainage channels following heavy rainstorms, but the resistance afforded by the vegetation would tend to hold the water back; and since the soil would be held firmly by the roots, the channels would tend to flatten out rather than become more prominent.

Where it is no longer possible for the vegetation to hold the soil intact, some means of artificial control is necessary. The gully

systems can usually be effectively broken up by the construction of terraces laid out approximately at right angles to the gullies but so placed as to allow water to be carried through their channels. If reinforced by small rock fills built into the washes at sufficiently frequent intervals to check the run-off before the cumulative effect of the water's force becomes uncontrollable, the terraces appear to be effective.

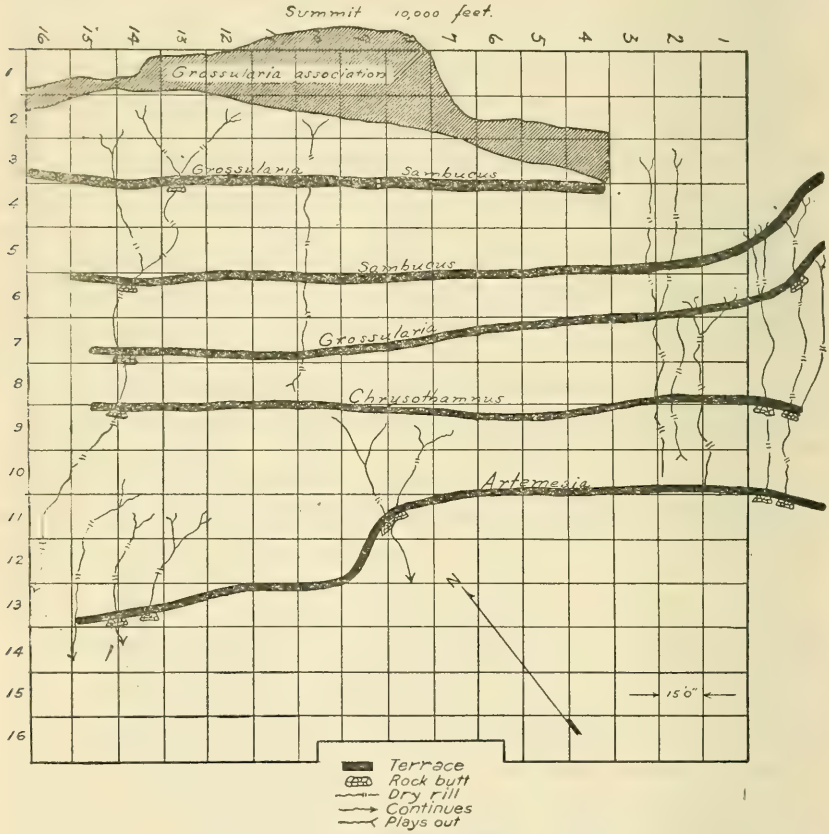


FIG. 7.—Tree and shrub planting to check erosion.

The place of successful attack of an evil like the one in question is at the origin of its source. In order thoroughly to test the value of terraces located near the heads of the gullies and planted to soil-binding species, a badly gullied area was selected on a southwest slope at an elevation of approximately 10,000 feet. This study is still in an experimental stage. As shown in figure 7, the distances between the terraces which were established vary considerably, being determined by the number of gullies and other topographic features.

In establishing a terrace, strips are plowed about 4 feet wide, or even wider on the steeper slopes, following which the loosened soil

is smoothed out by means of a homemade terrace drag (fig. 8). The drag is constructed in a V-shape and can be made any width provided the proportions are followed as given in the sketch. In order that the drag may work effectively one or two men usually stand on the crosspiece supporting the side beams. As soon as the terrace is well smoothed it is ready for planting.

Planting early in the spring before growth has started has given the best results; and since the soil can not be worked satisfactorily at that time terraces can best be established in the autumn. At the intersection of the more prominent gullies and the terraces, the former are built up with rock butts and overlaid with soil. In order to hold the terrace soil as effectively as possible, the terraces are planted to such soil-binding species as wild gooseberry (*Grossularia*), mountain elder (*Sambucus*), yellow brush (*Chrysothamnus*), sweet sage (*Artemisia*), yarrow (*Achillea*), and several species of sub-

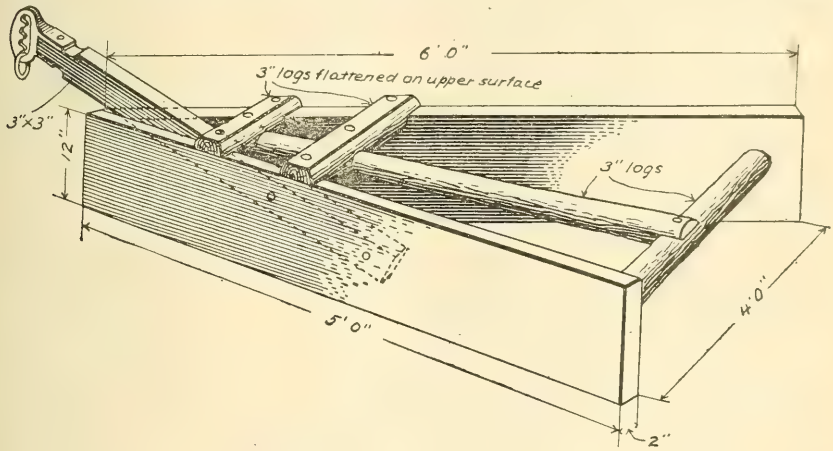


FIG. 8.—Terrace drag.

alpine grasses. Since seed of native grasses, which soon become firmly established on the terraces, can not be purchased from commercial seed houses it has been necessary to collect seed wherever a good crop developed naturally. However, following the establishment of the terrace a great deal of seed of native species is caught during the natural seed dissemination period in the autumn, and in two seasons or so the terraces become fairly well vegetated. As the soil is enriched through the accumulation of decayed vegetable matter, conditions for growth are gradually made more favorable and the vegetation develops luxuriantly.

The area experimented with, prior to the establishment of the terraces and fill work, had been subject each season to serious erosion. Since the establishment of the terraces and supplemental work, no erosion whatsoever has occurred and the lands are generally becoming

revegetated. The establishment of terraces and subsequent planting to suitable native species, therefore, offers considerable promise on lands that have eroded to such a point that revegetation is extremely slow and the subterranean parts of the vegetation uneffective in binding the soil and in preventing erratic run-off. The cost of the establishment of terraces will vary greatly according to the depth and number of gullies and the amount of fill work necessary. Where a moderate stand of native vegetation occurs within the vicinity of the terraces it will not be necessary to plant directly, provided a satisfactory seed crop is produced.

CONSTRUCTION OF DAMS.

In various parts of Europe, notably in the Swiss Alps, and to a less extent in this country, elaborate earth, stone, and concrete dams have been constructed where the less expensive contour terraces are inadequate in preventing continued destructiveness from erosion in critical localities. Obviously, the construction of elaborate dams is expensive and their use is limited to situations where the destruction to personal and other property is of much more than average seriousness. Problems of this character properly fall under the scope of engineering.

SUMMARY OF PREVENTIVE AND REMEDIAL MEASURES.

The maintenance of an effective vegetative cover may be accomplished by the following means:

1. Avoidance of overgrazing.
2. Avoidance of too early grazing.
3. Deferred and rotation grazing.
4. Artificial reseeding (in choice sites only).
5. Proper control and distribution of stock.

Where the depletion of the soil and the formation of long established gullies make thorough revegetation impossible, destructive floods and erosion may be controlled in the following ways:

1. Total exclusion of stock.
2. Terracing and planting.
3. Construction of dams.

CONCLUSIONS.

1. Erratic run-off and erosion have been responsible for a great deal of damage on western ranges where the vegetative cover had previously been materially decreased or practically eliminated.

2. Though the damage from erosion usually is measured merely by the injury caused to farm land and works of construction, the damage to the forest range lands upon which erosion occurs is often

greater and shows itself in decrease in carrying capacity of the lands.

3. While topography, climate, and soil are the primary factors in determining erosion, the combination of these factors on the lands under consideration is such that erosion is slight where the native ground cover has not been greatly disturbed. The seriousness of the erosion, therefore, is largely determined by the extent to which the ground cover is maintained.

4. Serious erosion on western range lands is due chiefly to the destruction of the vegetation as a result of overgrazing and mismanagement of live stock.

5. The sum of conditions favoring destructive run-off and erosion is most pronounced in the fan-shaped drainage basins of the spruce-fir type (on the Manti National Forest between 9,000 and 10,500 feet), where the ground cover is naturally rather sparse, where there is a characteristic sparseness of tree growth, and where the most desirable summer sheep ranges are located.

6. To maintain an effective vegetative cover, overgrazing and too early cropping of the herbage must be avoided, deferred and rotation grazing should be applied, and stock should be properly controlled and distributed at all times in the season.

7. In the case of incipient erosion, only slight changes in the use of the lands are generally necessary, and these changes do not necessarily imply even a temporary financial loss.

8. Where erosion has had full play for a number of years, the reestablishment of the ground cover, even though grazing is discontinued, does not always afford adequate protection. In such instances, which fortunately are relatively rare in this country, a combination of terracing and planting or, in exceptional cases, the construction of dams is justified.

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BULLETIN No. 651

OFFICE OF THE SECRETARY

Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ May 8, 1918

A FARM-MANAGEMENT STUDY IN ANDERSON COUNTY SOUTH CAROLINA

By

A. G. SMITH, Agriculturist

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(Revision of Department Bulletin 71)

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LOGAN WALLER PAGE, Director

Washington, D. C. PROFESSIONAL PAPER June 6, 1918

THE WET LANDS OF SOUTHERN LOUISIANA AND THEIR DRAINAGE

By

CHARLES W. OKEY

Senior Drainage Engineer

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W. J. SPILLMAN, Chief

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FARM ORGANIZATION IN THE IRRIGATED VALLEYS OF SOUTHERN ARIZONA

By

R. W. CLOTHIER, Agriculturist

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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 659

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Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ June 17, 1918

A FARM MANAGEMENT STUDY OF COTTON FARMS OF ELLIS COUNTY TEXAS

A STATISTICAL STUDY OF THE INVESTMENT IN LAND AND EQUIPMENT, COST OF OPERATION AND OF PRODUCTION OF CROPS, AND INCOME FROM DIFFERENT TYPES OF TENURE IN 1914

By

REX E. WILLARD, Agriculturist

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Contribution from the Office of Public Roads and Rural Engineering
LOGAN WALLER PAGE, Director

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HIGHWAY COST KEEPING

By

JAMES J. TOBIN and A. R. LOSH
U. S. Engineer Economists

Reviewed by

HALBERT P. GILLETTE
Consulting Cost Engineer

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Contribution from the Bureau of Chemistry
CARL L. ALSBERG, Chief

Washington, D. C. ▼ April 25, 1918

THE PREVENTION OF BREAKAGE OF EGGS IN TRANSIT WHEN SHIPPED IN CARLOTS

By

M. E. PENNINGTON, Chief, Food Research Laboratory, H. A. McALEER, Investigator in Poultry and Egg Handling, and A. D. GREENLEE, Assistant Chemist, assisted by F. X. DAILEY and H. C. ALBIN

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Contribution from Bureau of Markets
CHARLES J. BRAND, Chief

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CAR-LOT SHIPMENTS OF FRUITS AND VEGETABLES IN THE UNITED STATES IN 1916

By

PAUL FROEHLICH, Assistant in Market Surveys

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Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. November 18, 1918

THE MANUFACTURE OF NEUFCHÂTEL AND CREAM CHEESE IN THE FACTORY

By

K. J. MATHESON AND F. R. CAMMACK
Of the Dairy Division

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Contribution from the Forest Service
HENRY S. GRAVES, Forester

Washington, D. C. PROFESSIONAL PAPER April 19, 1918

PRODUCTION OF LUMBER, LATH AND SHINGLES IN 1916

By

FRANKLIN H. SMITH and ALBERT H. PIERSON
STATISTICIANS IN FOREST PRODUCTS

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RANGE PRESERVATION AND ITS RELATION TO EROSION CONTROL ON WESTERN GRAZING LANDS

By

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